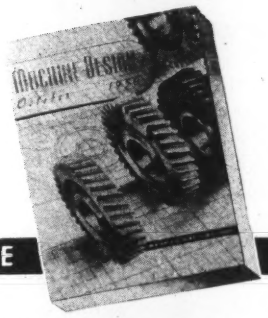

This Month's Cover: Selecting the right material for the right place is the theme portrayed, symbolizing the Seventeenth Edition of the Directory of Materials published in this issue. The cover was created by Robin Allen and rendered by George Farnsworth, Penton artists.

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CCA NBP

MACHINE DESIGN

Vol. 22—No. 10 **October, 1950**

THE PROFESSIONAL JOURNAL FOR ENGINEERS AND DESIGNERS

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DESIGNING FOR PRODUCTION AND SALES • STYLING
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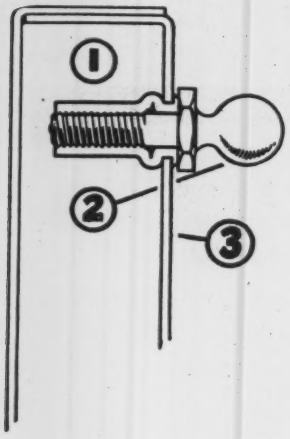
MD

3 tough fastening problems solved by one RIVNUT!



KITCHEN CABINET designers needed a rivet that 1) could be installed from one side only, 2) would serve as a nut plate for a knob attachment, and 3) could be installed *after* enameling. A B. F. Goodrich Rivnut proved the perfect answer.

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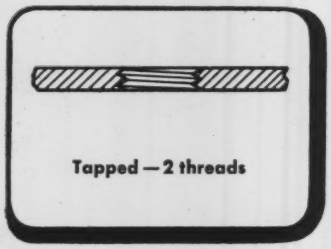
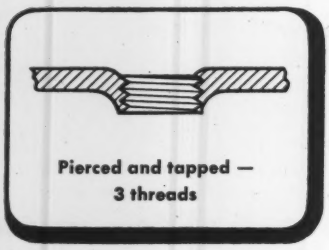
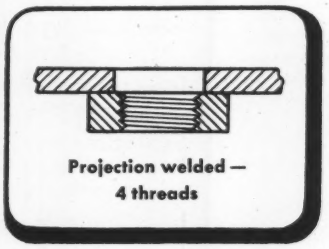
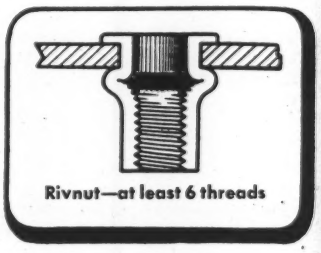
Compare these 4 methods of putting screw threads in thin sheet metal

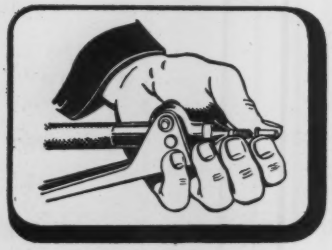




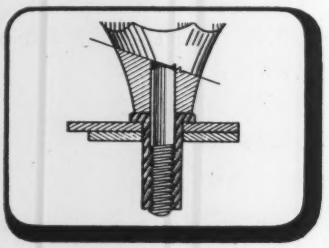




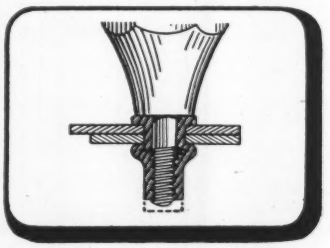
Rivnuts provide at least 6 clean threads in one simple operation!



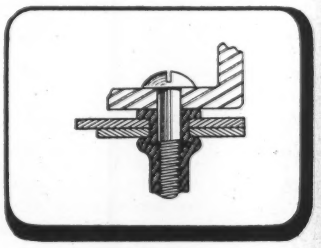
1. Rivnut is threaded onto pull-up stud of a manual or pneumatic heading tool.



2. Rivnut is inserted—head firmly against work, tool at right angles to work.



3. Tool lever operates pull-up stud, forming a bulge in the Rivnut shank.



4. After upset, Rivnut threads are still clean and intact, ready for screw attachment.

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Blaw-Knox Division of Blaw-Knox Company
Chain Belt Company
Jaeger Machine Company
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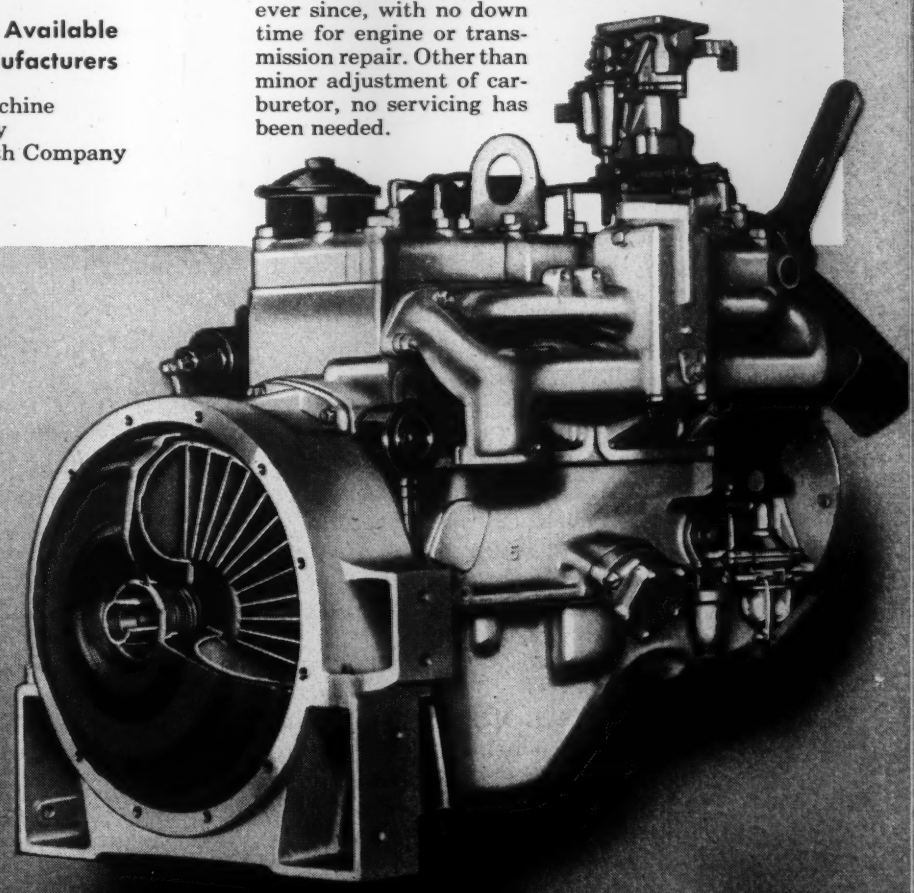
A Typical Experience

Five years ago, a Rex Moto-Mixer equipped with Chrysler Industrial Engine and gýrol Fluid Drive was placed in operation by the Tews Lime and Cement Company of Milwaukee. The unit has been operated continuously ever since, with no down time for engine or transmission repair. Other than minor adjustment of carburetor, no servicing has been needed.



Chrysler gýrol Fluid Drive is built integral with Chrysler Industrial Engines. Its cost is only a few dollars more than the conventional flywheel which it replaces.

CHRYSLER

Industrial Engines and Power Units

HORSEPOWER WITH A PEDIGREE

TOPICS

INDUSTRIAL DESIGN TRENDS reported by Sundberg-Ferar are (1) a departure from streamlining to a more "tailored" appearance; (2) greater use of plastics and bright metals, such as anodized and textured metals; (3) functional combination of advanced engineering and new materials, so that "elegance and grace of line" replace bulk and unnecessary weight.

LATEX COATING for protection of machinery and metal parts in shipping and storage has been developed in England. Preventing minor mechanical damage and corrosive effects, the rubber coating may be stripped easily without requiring a solvent or hot melt.

BRAZING AND SOLDERING with a "gun" for rapid continuous operation has been announced by the Metallizing Company of America. The gun feeds the brazing or soldering wire at a speed synchronized with that of the work. Brazing speeds range from 60 to 120 lineal feet per minute on typical installations.

STREAMLINING the front of a ship's superstructure to lessen wind pressure and satisfy esthetic taste produces a phenomenon brought home forcibly to the unwary passenger. By Bernoulli's law, a decrease in wind pressure is accompanied by an increase in wind velocity. According to a test recently reported in England, relative wind speed of 70 knots on a boat deck was increased by the streamlined form to more than 175 knots, the limit of the pitot-tube gages used for the observations.

MAGNESIUM CUPROUS CHLORIDE BATTERY activated by tap water has been developed by the Signal Corps Engineering Laboratories. Developed primarily for high-altitude meteorological research, the new battery weighs 400 grams, operates down to −65 F, has a capacity of 12 watthours, and occupies 16 cubic inches.

PERPETUAL MOTION of a rather scientific order has been achieved but its usefulness remains to be established. In rings of certain metals held at very low temperatures, electrons circulate endlessly after the initial voltage has been cut off. An intense magnetic field remains constant for hours. This condition is reached with columbium at a temperature of 9.22 K, mercury at 4.12 K and zinc at 1.79 K.

GLASS-FIBER pipe and tube material of high strength and light weight has been developed by U. S. Plywood Corp. It is a laminated tubing in which glass fibers, in the form of cloth, mat or tube, are bonded with resins.

AFT-FACING PLANE SEATS are being installed in military aircraft. Having three times the strength of previous models, the new seat was developed after studies showed that humans riding backward can withstand greater shock in the event of a sudden stop.

COLLOIDAL GRAPHITE added to the engine oil of an automobile is credited with savings of 30 per cent in oil and 10 per cent in gasoline over a 235,000-mile test run. According to Acheson Colloids Corporation, colloidal graphite particles, "unctuous and microscopically fine," adhere tenaciously to metal cylinder walls and bearings. The "graphoid" surface supports a thinner film of lubricant without rupture than does the metal alone.

RATE DRIFT OF TIMEPIECES over an interval of several days is recorded graphically by an instrument developed by H. A. Bowman, National Bureau of Standards. A servo system keeps the phase of a crystal-controlled standard frequency in step with the frequency of the timepiece. Shift required of the standard to match the unknown is plotted against time to provide a curve from which both the instantaneous and integrated errors are obtained.

ELECTRICAL UNITS have been revised by Congress in a formal sanction replacing a law enacted 56 years ago. In large part, the values adopted for the units resulted from research by the National Bureau of Standards. Although none of the changes exceeds 1/20 of one per cent, the new law places the values on an unambiguous basis, assuring the closest practicable agreement of electrical and mechanical units.

OCTOBER, 1950

The Right Material in the Right Place

AS IF the problem of selecting engineering materials were not sufficiently complicated already, designers must also grapple with the complex question of heat treatment. With the variety of alloys—standard and tradenamed—now available, plus the variety of properties which can be imparted to them by heat treatment the choice before the design engineer today is well-nigh overwhelming.

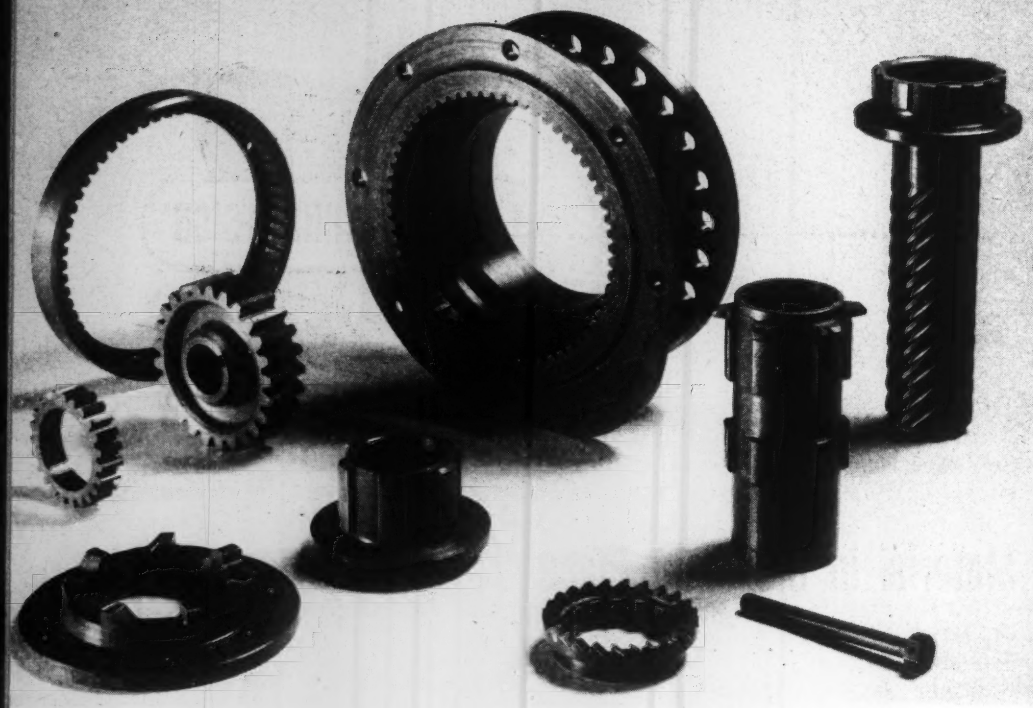
Instead of becoming discouraged by the seeming complications of selection, designers might well take heart from the fact that these many combinations of alloys and treaments make available almost any conceivable combination of properties required in design. The only difficulty is that much of the published information fails to aid the designer in developing an intelligent approach to materials selection and heat treatment.

Having long been aware of the need for a systematic approach to the heat treatment of steel from the designer's viewpoint, the editors are particularly gratified to be able to present in this issue the first of a three-part series of articles on "What Heat Treatment?" Little concerned with the highly technical aspects of metallurgy, the articles constitute a thoroughly practical, simplified guide to a complex subject. How the various heat-treating processes fit into the production program, how the properties imparted to the steel at various stages affect processability and service performance, and how these treatments should be specified on drawings are clearly set forth, always with the specific needs of the designer in mind.

It is hoped that this new systematic approach will contribute toward a clear understanding by designers of the potential economic gains resulting from selection of the right material with the right heat treatment for the right place.

Colin Carmichael

EDITOR



courtesy Westinghouse Electric Corp.

HEA

By Norman N. Brown
Resident Manager
Cincinnati Branch
Wheelock, Lovejoy & Co. Inc.
Cambridge, Mass.

SOME knowledge of steels and their treatment, what they can and cannot do, and which one is best or most suitable for a specific part is necessary in the designing of mechanical equipment. In the majority of cases the designer knows fairly closely to what stresses the particular part being designed may be subject. In general, there are numerous cases, where the stresses and wear are negligible, in which untreated plain-carbon steels are satisfactory. But, at the same time, there are equally numerous other cases which, owing to service conditions, call for treatment of some kind.

Many a designer has wrestled with the problem of specifying steels and treatments so that the physical properties desired in his parts would be assured. To assist in attacking this problem from a practical design standpoint, this series of three articles will present an overall analysis of the subject. It is recognized, of course, there are many jobs that require considerable research and investigation, involving the services of metallurgists and the steel companies, which of necessity cannot be anticiapted in a discussion of this nature.

From the viewpoint of the designer or engineer, a practical approach to this subject would start with the physical properties of the proposed part. These can be divided into three major categories:

1. Toughness
2. Hardness
3. Combination hardness and toughness.

The outstanding or principal physical property necessary for the part in question to function properly will determine in which group the most likely steel and treatment is to be found.

Before proceding further it might be well to restate a few basic facts which were broadly discussed in a previous article ("Steels and Their Treatment," MACHINE DESIGN, Oct. and Nov., 1948) concerning the steels themselves. Usually, more than one steel can be found to satisfy the necessary needs of a part and in the final selection the price, processability and availability influence the final decision. The tabular arrangement of *Fig.* 1 shows brief groupings of standard steels. Those in any one group may be used interchangeably, in varying degrees, depending upon the specific design requirements of the parts involved. There are, of course, many other grades, including tradename steels, not included in this brief list. It can be enlarged or revised, and steels checked for availability with the various steel companies according to the needs of individual design departments.

Subsequent treatment desired may determine whether to specify one of the steels in the list with a cold-drawn or hot-rolled finish. From the standpoint of treatment alone a part made from a cold-drawn steel will distort more, because of the cold drawing strains in the steel, than if it were made from a hot-rolled steel unless some compensating treatment is employed.

TREATMENTS: There are, roughly, six types of heat treatments—three in the nonquenching class and three in the quenching class:

Nonquenching types
1. Stress relieving
2. Annealing
3. Normalizing

Quenching types
4. Case hardening (pack, gas and liquid carburizing, etc.)
5. Surface hardening (flame and induction)
6. Through hardening (water quench, oil quench, interrupted quench, etc.)

In the three major categories of physical properties mentioned earlier, the treatments which may be involved singularly or in combination are as follows:

TREATMENTS

. . . Their Selection and Specification in Design

Part 1—Toughness

Group I	Group II	Group III	Group IV	Group V
C-1015-20 B-1112 C-1117	A-5120 A-8620 A-3115-20 A-4615-20	C-1035-45 C-1137-41 A-1335	A-5140 A-4145 A-8642 A-3140 A-4640 A-6145	A-4340 A-3250 A-2345

Fig. 1—Standard AISI steels grouped according to similarity of physical properties. Those in any one group may be used nterchangeably in varying degrees depending upon the parts being designed. Also, each group is listed generally according to cost, those at the top being less expensive than those at the bottom

Toughness

Stress relieving	Normalizing
Annealing	Through-hardening

Hardness

Stress relieving	Case hardening
Annealing	Surface hardening
Normalizing	Through-hardening

Combination Hardness and Toughness

Stress relieving	Case hardening
Annealing	Surface hardening
Normalizing	Through-hardening

It will be noticed that stress relieving, annealing, normalizing, and through-hardening occur in all three categories. Although the cause and effect of the normalizing and through-hardening may vary, the reasons for using the first two treatments are generally the same in each case. Also, they are generally used as an auxiliary to one of the other treatments. Therefore, it is probably in order to discuss stress relieving and annealing first and then embark upon a study of the other treatments involved in obtaining *Toughness, Hardness,* and *Combination Hardness and Toughness.*

Stress Relieving: Cold working or work done under the critical point of a steel (roughly under 1425 F) will induce stresses which, unless relieved, frequently cause difficulties in subsequent processing. The usual stress relieving treatment involves heating the steel to some point under the critical temperature (depending upon the circumstances) and cooling not too rapidly in air. Common instances where this treatment should be considered are as follows:

1. *After machine straightening,* especially if the bar or bars are going to be machined in comparatively long lengths. This is particularly in order in the case of steel that has been straightened after heat treatment so distortion can be held to a minimum in the machining operations to follow
2. *After machining and before heat treating.* The more intricate or the more slender the part (and assuming it is desired to hold distortion to a minimum) the more desirable this treatment becomes.

More specific applications of this simple, but highly effective treatment, will be discussed later.

Annealing: Medium and high-carbon steels (generally over 0.40 per cent carbon) usually have to be softened to improve their machinability. This is done by heating the steel above the critical temperature and cooling slowly in a furnace. There are, of course, several exceptions in which medium-carbon steels (0.35 to 0.50 per cent carbon) are machined in the "as-rolled", "normalized" or "heat treated (quenched and drawn)" condition which will be discussed later. The main point for the designer or engineer to keep in mind, particularly when specifying medium-carbon steels, is to state definitely in what

condition the steel is to be furnished. There are some free machining steels on the market, such as AISI A-1137-41 and some well-known tradename grades that are usually furnished as-rolled. But others such as AISI C-1045, A-4140, etc., are furnished in various conditions and, unless the specification is definite, the steel supplier would not know which is desired.

Whether to start with one of the tougher machining steels (C-1045, A-4140, etc.) in the as-rolled or annealed condition depends upon the ability of the shop involved to machine them or upon the amount of machine work or both. Also, if the steel is to be first forged then as-rolled stock is satisfactory.

While plain, medium-carbon steels are frequently used in the annealed condition (even when somewhat lower carbon steels or free machining medium-carbon grades could be used in the as-rolled state to just as good advantage and at less cost), the alloy steels should be used in service in the heat-treated condition to take advantage of the inherent physical properties of the material. It follows logically that annealing is only a preliminary treatment in such instances. *Fig.* 2 points out some types of steel used in the manufacture of a modern machine tool.

With this discussion of general points to be considered it is now possible to go into a more intelligent investigation of specific treatments and steels to obtain the physical properties required of various parts.

Treatments for Toughness

TOUGHNESS: This property can be generally considered as resistance to torque, impact, fatigue, or pull. Treatments to meet these requirements are discussed in the ensuing paragraphs.

Normalizing (as related to toughness): This involves heating the steel to some point above its critical temperature and cooling in air. Because of the simplicity of the mechanics of the operating, the cost ranks with the lowest of any of the various treatments. Its effectiveness depends upon any one or any combination of three factors in the steel: (1) Carbon content, (2) amount of alloying element, and (3) mass. In *Fig.* 3 is charted, in an elementary manner, the approximate relationship of normalized hardness to carbon content in a steel.

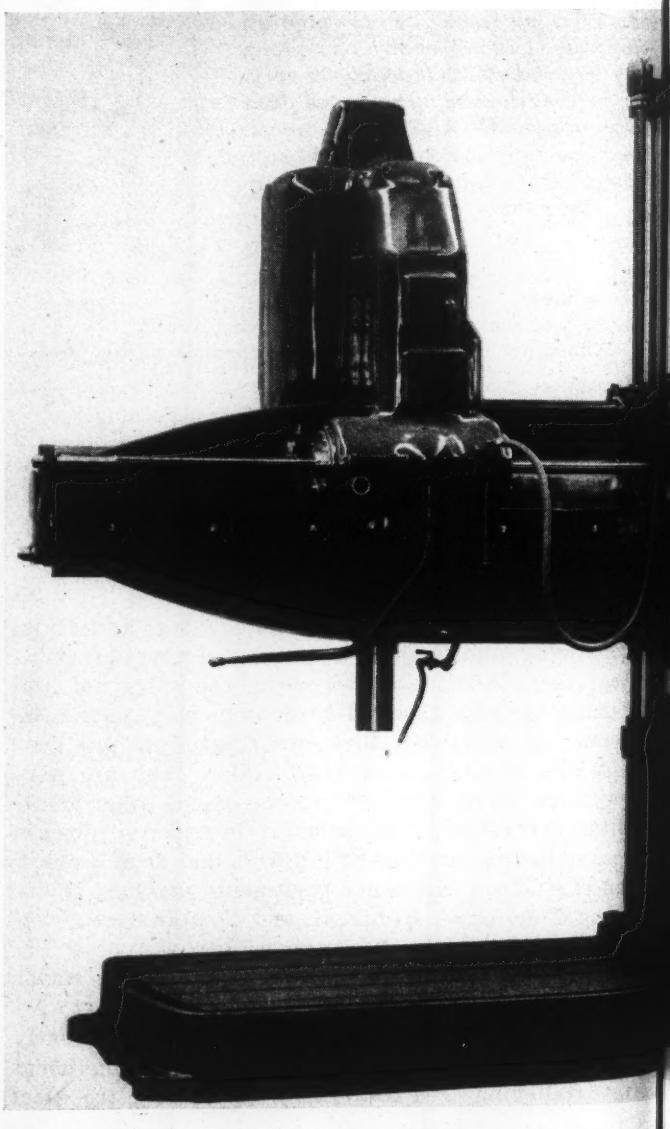
When this treatment is used in the interests of toughness it is generally applied to medium-carbon steels when somewhat better physical properties than those of as-rolled stock are desired. Parts include axles, arbors, studs, bolts, etc., that are not highly stressed in service. Hardness may vary from about 235 to 311 Brinell depending upon the size and grade of steel. If for some reason the hardness developed is higher than that desired, occasionally the material is tempered (drawn) after normalizing. It should be kept in mind that this treatment is specified only when the physical requirements are not exacting. In most instances the steel thus treated can be machined without too much difficulty.

An unusual example of the use of normalizing combined with stress relieving is in the processing of long slender spindles for a machine. In one case where distortion during machining had to be kept to an absolute minimum a 0.40-carbon, free machining steel was used so that machining strains would be low. In order to further this end and at the same time increase the physical properties, it was decided to normalize, machine straighten, and stress relieve to eliminate straightening strains. The result was a steel that remained straight throughout the machining operations and performed satisfactorily in use.

Another application of normalizing is in the case of extremely large bars of the medium-carbon grades (over 10 or 12-inch cross section and depending upon the alloying elements present in the steel) which often do not respond well to regular quenching treatments because of the mass which retards the cooling rate necessary to develop good hardness. In such cases normalizing, which costs less than quenching, is resorted to with results comparable to quenching.

Large calender rolls in the paper industry often are handled in this manner. These bars may be machined from AISI A-4150 steel, 15 to 18 inches in diameter, which has been normalized and tempered to a hardness of about 250 Brinell.

Through-Hardening (as related to toughness): This involves heating the steel to some point above its



critical temperature, quenching and tempering (drawing). In the interests of toughness alone usually hardnesses under 300 Brinell are specified and usually steels in the medium-carbon bracket are employed although occasionally a low-carbon alloy steel is effective. Most of these steels can be machined without much difficulty under 300-Brinell hardness, but naturally their machinability will vary at any given hardness with the analysis. Following is a brief list of AISI steels arranged generally in order of their machinability in the heat-treated condition with the better machining grades listed first:

1. A-4640
2. A-4145
3. A-8642
4. A-4340
5. A-3140
6. A-5140
7. A-6145
8. A-2345
9. A-3250
10. C-1045

There are also some tradename steels on the market with physical properties similar to those listed above, that machine considerably better at any hardness.

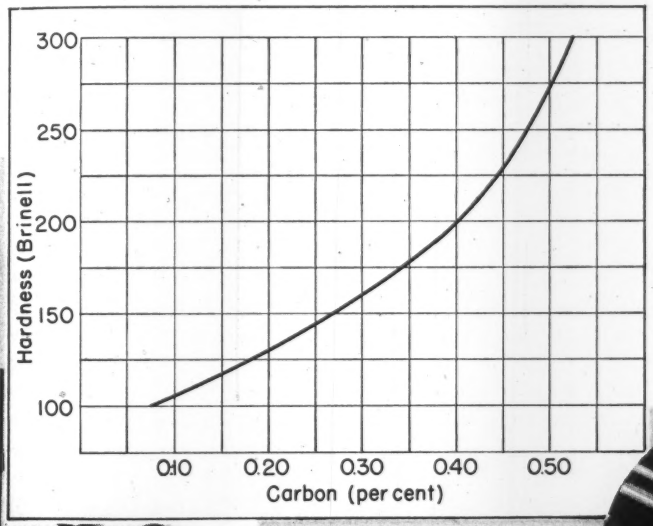


Fig. 3 — Chart showing approximate relationship of normalized hardness to carbon content for small sections. Size, alloy content and rate of cooling all have an effect on final hardness so this chart should be regarded as a comparative reference only

Obviously, if a steel can be machined economically in the heat-treated condition it is desirable to specify it for purchase in that condition. The gear shown in *Fig.* 4 was made from a special 0.50-carbon manganese-chromium-molybdenum alloy preheat treated to 240 to 280 Brinell. In this connection the specifications should be clear and not contradictory. As mentioned under Normalizing, the mass of the part or bar will affect the response of the steel to heat treatment and allowance should be made for this factor. Also, increasing the hardness will increase the tensile strength and yield point which is good for parts requiring resistance to static loads, pull and torque while at the same time the elongation, reduction of area, and impact values are reduced which is detrimental for parts requiring shock resistance.

Avoid Conflicting Specifications

Sometimes a drawing will specify both a hardness range and a physical property range, one range being incompatible with the other. In such cases it is generally better to specify either the physical properties desired or else the desired hardness rather than both unless the ranges shown are sufficiently wide to take all the variables into consideration.

Occasionally throughout this article reference will be made to interrupted-quench treatments of *Martempering, Austempering* and *Isothermal Treating.* Because of the mechanics of these treatments (discussed in "Steels and Their Treatments", referred to previously) distortion is usually less than if the part being handled were quenched in oil in the usual man-

Fig. 2 — Modern radial drill employs the following steel parts: Spindle, special heavy-duty medium-carbon heat-treated alloy forging; ways, hardened cast steel; gears, heavy-duty medium-carbon heat-treated alloy; spindle sleeve, nitrided Nitralloy; elevating and traverse screws, 0.35-carbon; arm elevating safety clutch, carburized low-carbon alloy; control rods and levers, cold-rolled steel

Photo, courtesy Fosdick Machine Tool Co.

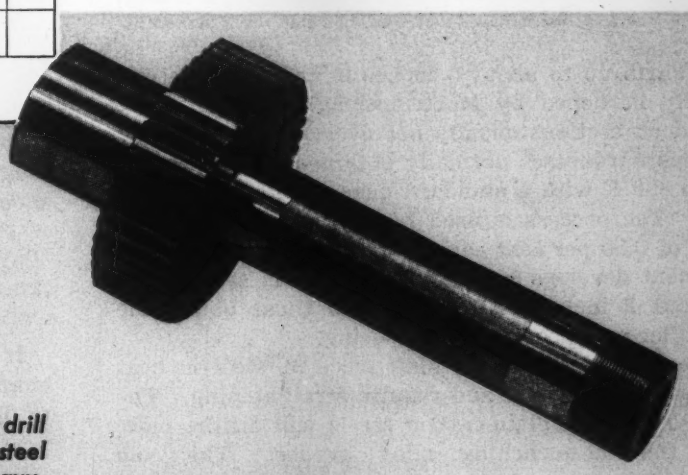
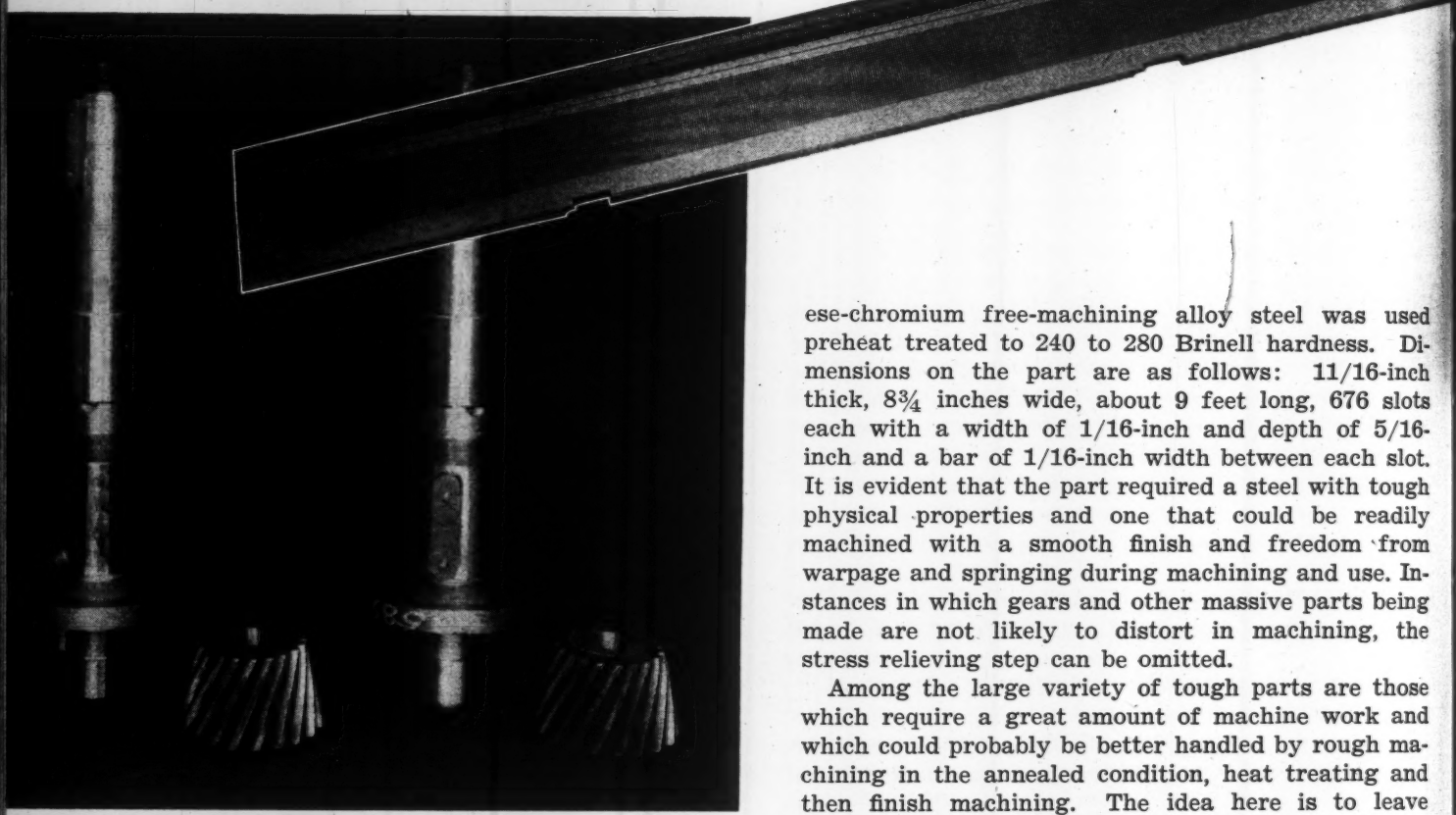


Fig. 4 — Gear for an automatic tapping machine made from preheat-treated medium-carbon alloy steel

Fig. 5—Right—Needle bed for a knitting machine made from a free machining special 0.40-carbon manganese-chromium heat-treated alloy steel

Fig. 6—Below—Coal pulverizer shafts and pinion gears made from AISI A-4340 owing to good response in large sections



Photo, courtesy International Nickel Co. and Babcock & Wilcox Co.

ner. Parts up to about 3 inches in cross section can be fully hardened by Martempering. Austempering is used on sections usually not over 1-inch thick and develops hardnesses normally obtained by drawing to 400 to 850 F with a standard quench-and-draw treatment. The process is used mainly on alloy and tool steels of 0.50 per cent carbon or over. The Isothermal treatment develops physical properties in sections up to about 2 inches thick similar to those obtainable in smaller sections by Austempering.

When a comparatively long piece of steel is heat treated it will distort and require straightening. The water-quenching plain-carbon steels will distort more than the oil-quenching alloy grades. The cold straightening operation sets up strains in the steel relative to the amount of straightening involved and unless these strains are eliminated by stress relieving, undue distortion will take place in subsequent machining operations. This is particularly evident if the parts being processed are comparatively long shafts, arbors, spindles, etc. In these instances the drawing specifications should be:

Heat treat
Stress relieve
Machine

The needle bed shown in *Fig.* 5 is an example handled in this manner. A special 0.40-carbon manganese-chromium free-machining alloy steel was used preheat treated to 240 to 280 Brinell hardness. Dimensions on the part are as follows: 11/16-inch thick, 8¾ inches wide, about 9 feet long, 676 slots each with a width of 1/16-inch and depth of 5/16-inch and a bar of 1/16-inch width between each slot. It is evident that the part required a steel with tough physical properties and one that could be readily machined with a smooth finish and freedom from warpage and springing during machining and use. Instances in which gears and other massive parts being made are not likely to distort in machining, the stress relieving step can be omitted.

Among the large variety of tough parts are those which require a great amount of machine work and which could probably be better handled by rough machining in the annealed condition, heat treating and then finish machining. The idea here is to leave enough stock for finish machining to remove any distortion that might take place in treating and thus reduce final grinding time to a minimum. This procedure is also applicable to steels that may be rather difficult to machine at the higher hardnesses of the toughness range. In these instances the specification should be set up to read as follows:

Anneal
Rough machine
Heat treat
Finish machine

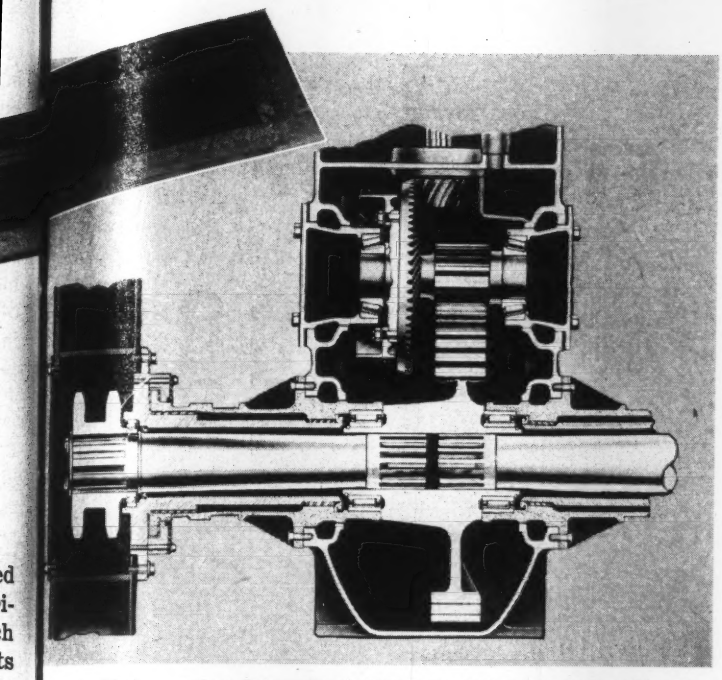
If it is satisfactory to heat treat the finish-machined part, as in the case of chunky parts not likely to distort to any great degree in treatment, the specification could read as follows:

Anneal
Machine
Heat treat
Grind

Forgings should be normalized prior to other treatments and processing in order to refine the grain structure and otherwise improve their response to subsequent processing. The specification should read:

Forge
Normalize
Anneal (or Heat treat) etc.

As mentioned before, the mass of the section heat treated must be considered in selecting the right steel.



Photo, courtesy International Nickel Co. and J. D. Adams Mfg. Co.

Fig. 7—Cutaway view showing AISI A-4340 heat-treated steel axle in earth moving machine drive

Alloy steels respond better than plain-carbon grades and are generally more desirable to use on parts of medium and large cross section (over about 2½ inches). This difference in response to heat treatment is shown in the following tabulation:

AISI No.	Size (in.)	Bhn	Ten str (psi)	Yield (psi)	Elong. (% 2 in.)	Red. Area (%)
C-1050	¾	302	135,000	111,000	18	54
A-4150	¾	302	142,000	125,000	18	60

Within the alloy steel grades there is comparatively little difference in physical properties, under 30 Rockwell C, between the "medium" and "rich" alloys (Groups IV and V, *Fig.* 1). Rich alloys have somewhat better impact strength at the same hardness (up to about 30 Rockwell C). The pulverizer shafts shown in *Fig.* 6 are examples of large parts that are made from AISI A-4340 because of the good response of that steel to heat treatment in large sections.

Another point to bear in mind if distortion during treatment must be kept low is, as stated before, that water-quenching plain-carbon analyses (C-1045, etc.) distort more than the oil-quenching alloys (A-4145, A-4340, etc.) and compensation should be made for this.

Parts, such as armature shafts, that have to be particularly resistant to torque are usually made of medium-carbon alloy steels treated to the high side of the toughness range (about 30 Rockwell C) because the higher tensile strength (higher than that at the lower side of the hardness range) is beneficial. Application of this practice in the case of drive shafts (about 5 inches in diameter) for some cement manufacturing machines emphasizes its practicability. A special medium-carbon alloy steel heat treated and stress relieved (before machining) to 300 Brinell (about 31 Rockwell C) resulted in more than twice the life of the same steel used at about 250 Brinell.

In this toughness category, eliminating fatigue failures is a common and vexing problem. There are many variables that can combine to bring about such failures. Often, the most practical and effective solution in the event of actual failure is to increase the cross section or otherwise redesign the part slightly. Compressive stresses introduced by mechanical means (shot peening, rolling, etc.) or by surface treatments (carburizing, nitriding, etc.) also help. Through-hardening treatments which increase the tensile strength are also utilized because fatigue failures usually seem to start at the surface and are thought always to occur when stressed members are in tension rather than compression. In the case of carburized parts, fatigue failures sometimes start between the case and core.

Low-Carbon Alloys Effective

It has been found, when the part in question is not too large (sections under about 2 inches), that a heat-treated low-carbon alloy like AISI A-4615 is often more effective than a treated medium-carbon alloy. A pertinent instance with some rubber working machines points up this fact. Studs made from AISI C-1020 failed from fatigue. A heat-treated medium-carbon (0.50 per cent carbon) alloy steel was substituted with substantially the same results. AISI A-4615, heat treated and drawn at 1000 F, was then adopted with satisfactory performance. Similar results have been experienced with heat-treated A-4615 used for marine studs and other parts subject to severe vibration.

A general picture of the area of typical parts covered by the Toughness category of heat treating can be gained from the following brief listing: *Axles,* all types used in machines, *Fig.* 7; *drive shafts,* all types such as pump shafts, armature shafts, gear shafts, machine cutter and power spindles; *screws,* power screws, feed and lead screws, jack screws; *gears; bolts,* studs, tension bolts, U-bolts tie-rod bolts.

Taking up the discussion of the second category of physical properties in this study of heat treatments, their selection and specification will be Part 2 covering Hardness.

Production Processes in Book Form

Based on the series of articles of the same name, the new book, *Production Processes—Their Influence on Design,* makes available practical and down-to-earth information on economical design for manufacture. Introducing 36 chapters covering metal removal, metal forming, metal working and forging, and metal deposition methods are chapters on mass production and the philosophy of design for production along with major rules to observe in practice. Among the practical design aids included in this book is a basic chart showing the surface roughness, tolerance and cost ranges plotted for all the major production methods. Containing 568 pages and 652 illustrations, the 6½ by 10-inch volume, cloth-bound, is available from MACHINE DESIGN at $10.00 postpaid.

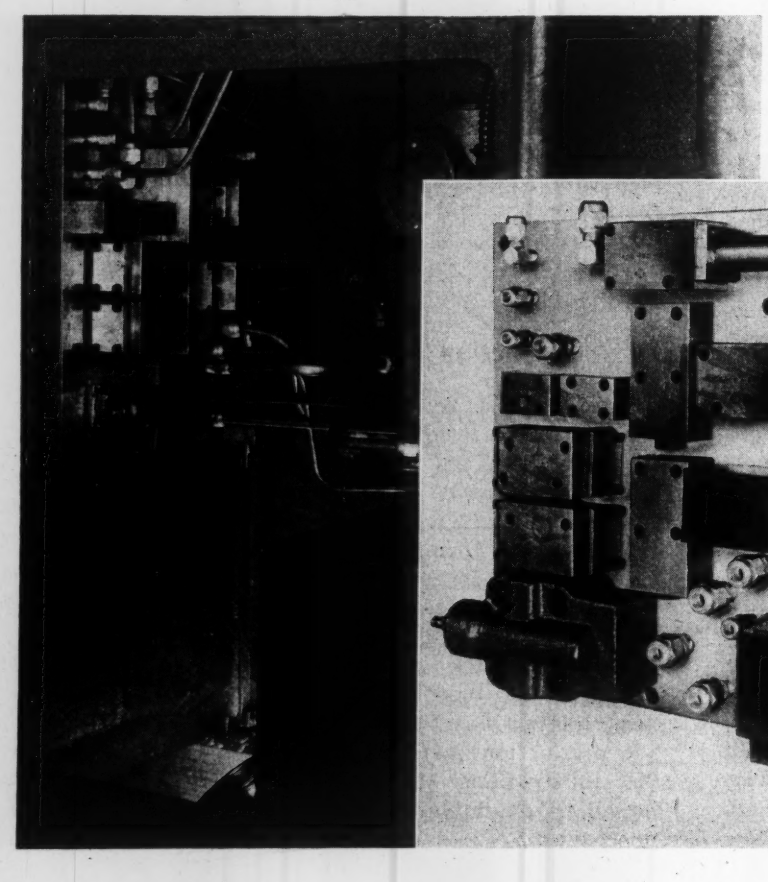
SCANNING the Field For Ideas

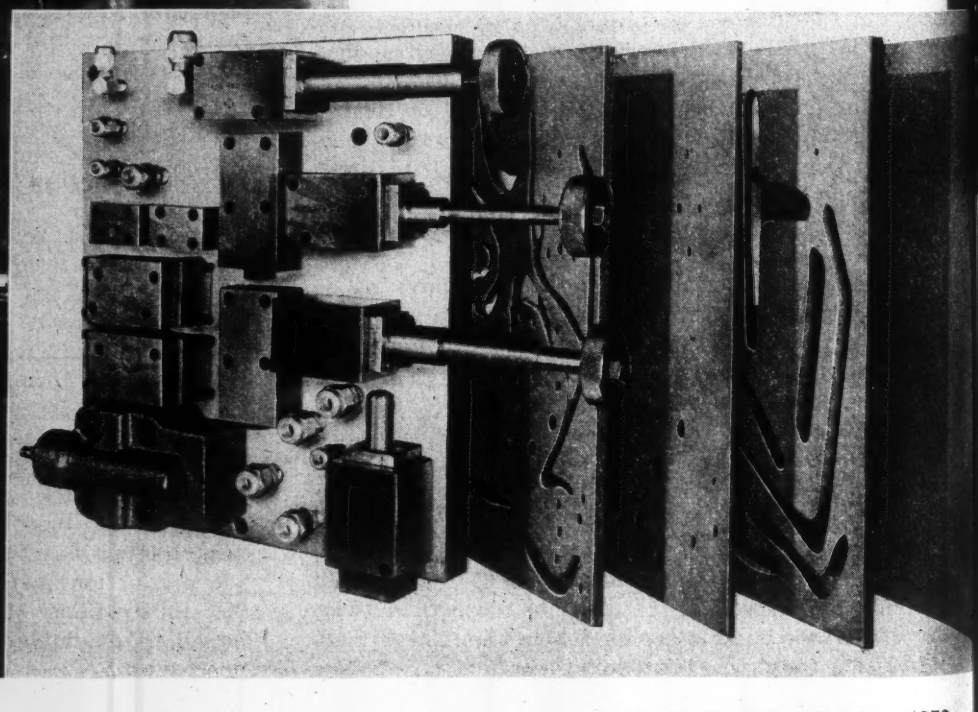
Manifolds for hydraulically operated machines simplify construction and maintenance as well as making neater and more compact assemblies. In addition to these desirable features, improved appearance and reduced costs offer definite sales appeal, especially for complex circuits where the maze of tubing otherwise involved would more than fill the space available. A new patented hydraulic manifold, developed by Almo Tool Co. for assembly by hydrogen brazing, is illustrated below both in an assembled and exploded view.

All the valving is assembled on the top plate of this five-plate manifold, the only gasketing being O-rings for valve mounting. The back plate is solid except for convenient mounting holes. The next flat plate has torch-cut channels for oil passages, while the middle plate has transfer ports to connect with similarly cut passages in the fourth plate which connects to the ports for valves and power lines on the top plate. All passages are cut generously large and arranged to have minimum length so that the power losses in the manifold are negligible compared with the conventional tubing assembly.

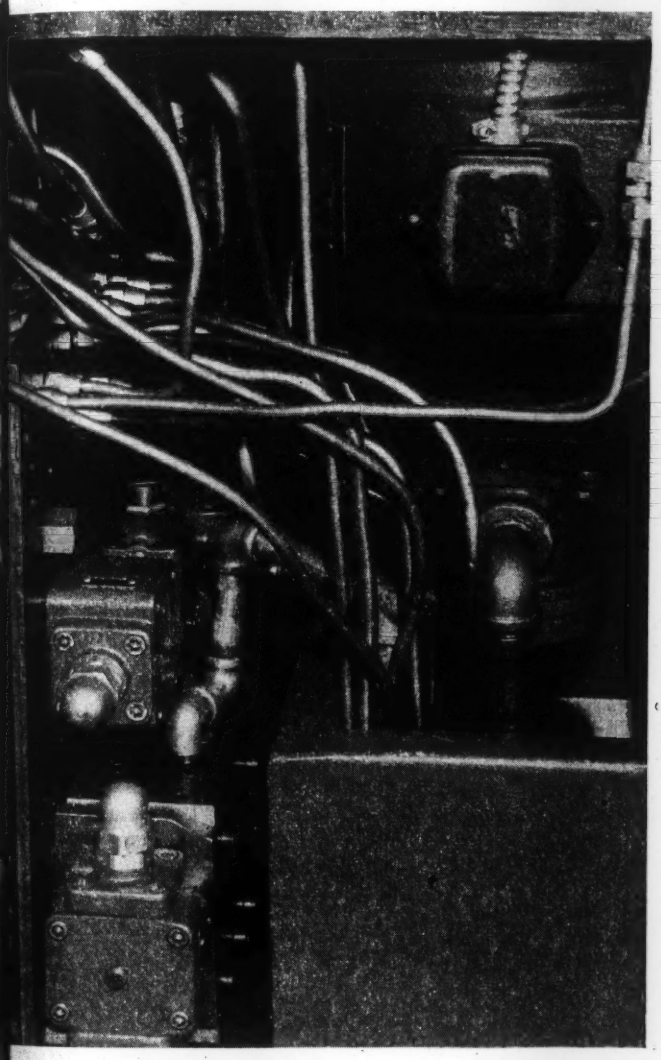
Copper is sprayed on the faces of each plate for the brazing operation. Then each plate is placed in position in an electric furnace and the stack is heavily loaded. Contact between all faces is assured because the furnace temperature is sufficiently high to relieve any warpage that might have occurred. Capillary action flows the copper between all contact surfaces and the excess copper flows out through the open ports, no copper remaining in the passages. Their surfaces become clean steel.

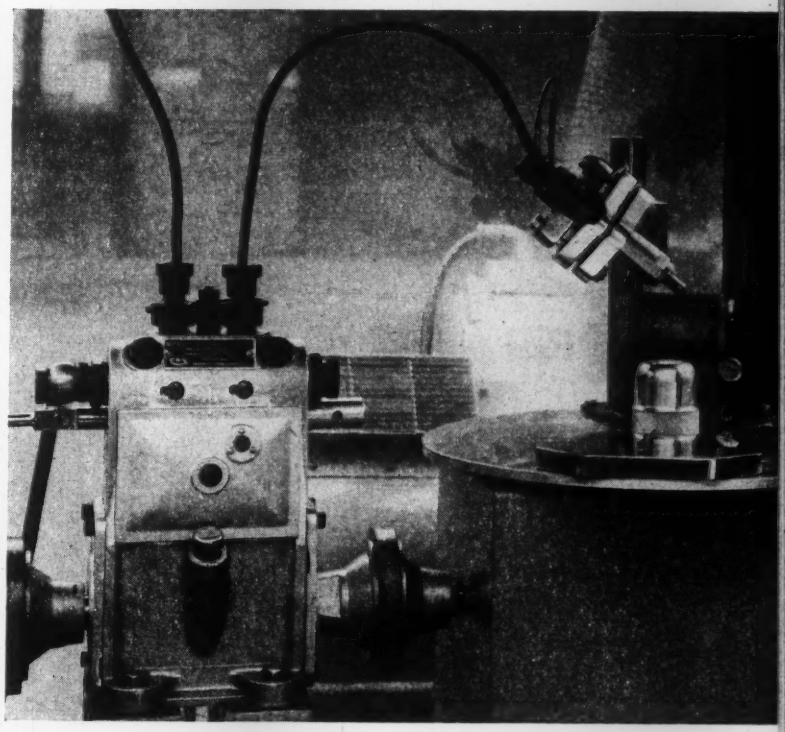
With the top plate drilled and tapped for valves and fittings, all that

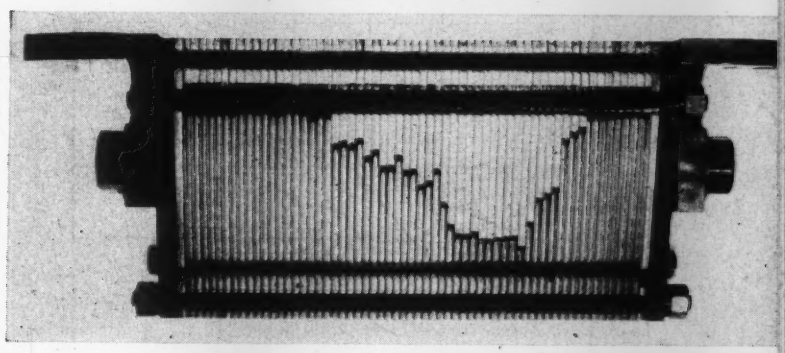




is required in machine assembly is to make the few necessary connections. To further reduce the size of the manifold, valves of special, compact, rectangular design are employed. The three control knobs shown extend through the front of the machine, obviating special mountings. Compactness of the manifold unit is evident from the assembled view showing the base of a Cadillac marking machine. For comparison, the same machine assembled with conventional tubing and fittings is illustrated below.





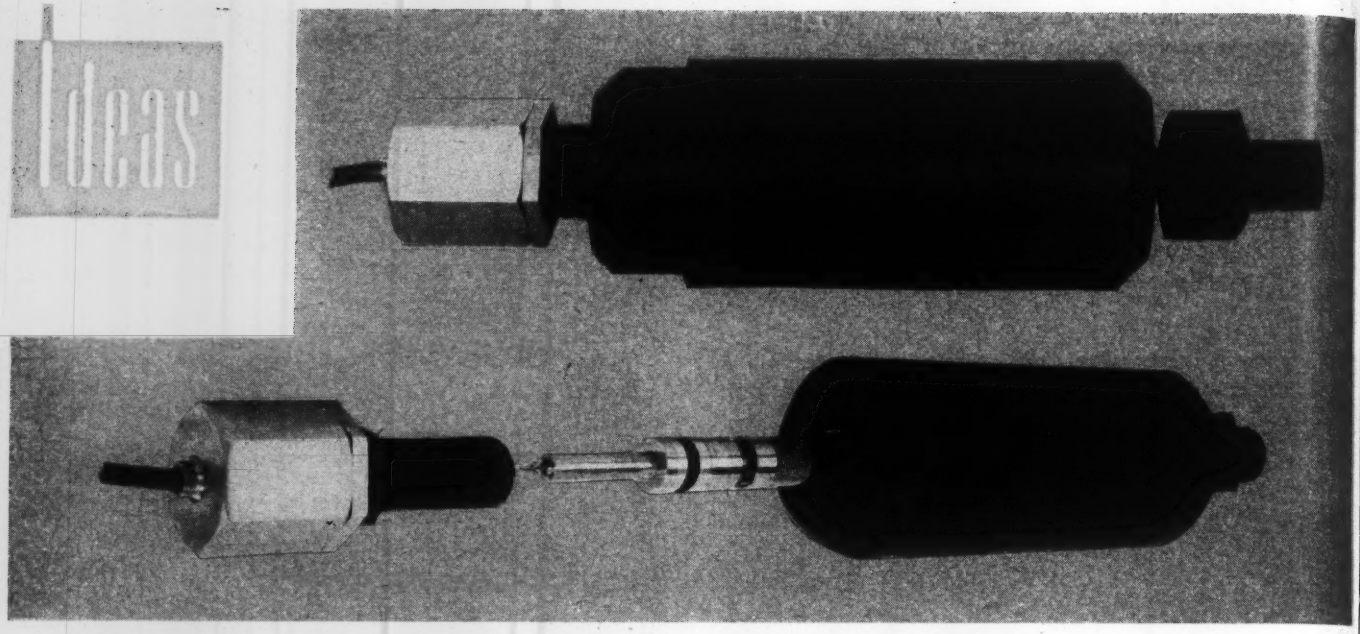


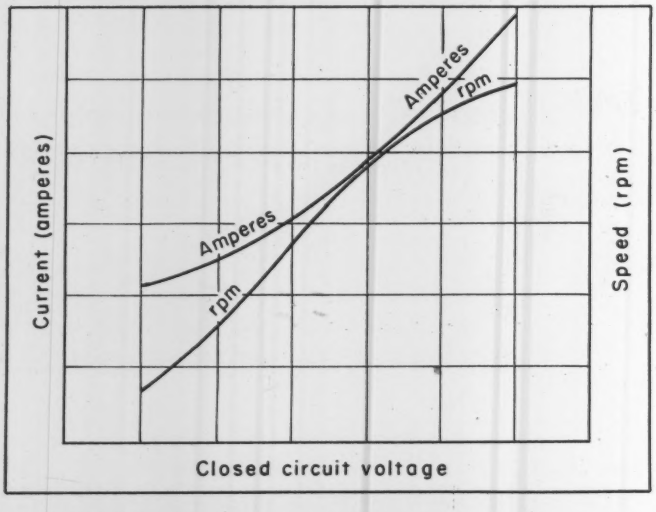
Injection rate analyzer, top right, measures the rate of fuel injected into a diesel engine cylinder during the critical combustion period. The object of this pilot injection system, developed experimentally by C. A. V. Ltd., London, England, is to provide for the injection of the first portion of the charge at a low rate, followed by the main charge at a higher rate when combustion takes place. With full control of injection, maximum engine efficiency is possible. For the purpose of obtaining the desired information, this analyzer was designed.

A pack of transparent slotted collecting cells is rotated on a turntable beneath a nozzle orifice, so that actual fuel injection during each fraction of camshaft rotation over a given number of injections is collected as a small fuel column in each cell. The cells are cut from clear plastic sheet and are separated by thin steel shim stock. The pack is rotated at pump camshaft speed, each cell representing ¾-degree of rotation. The photograph above shows a pack with the fuel injected during a test of typical pilot injection equipment. During a test the turntable is enclosed in a fume chamber and the jet is illuminated by stroboscopic light.

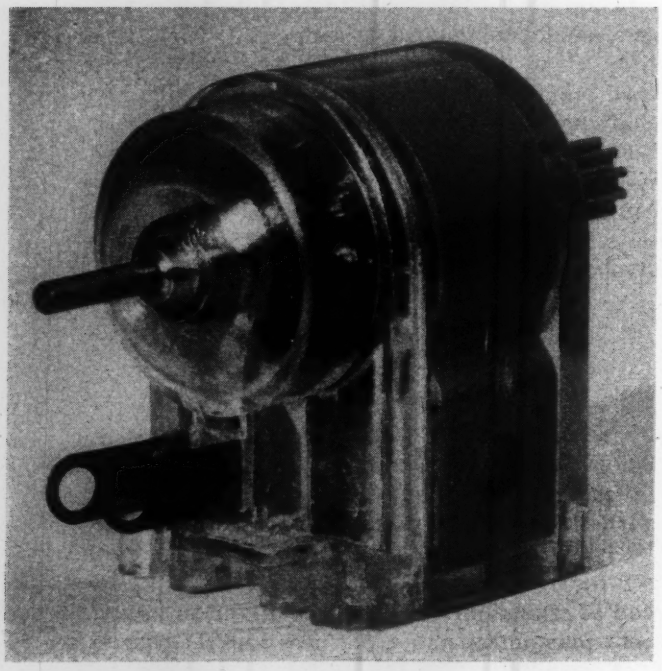
High-pressure measurements in the range of 50,000 to 200,000 psi are possible with the manganin cell illustrated top of next page, when used in conjunction with electronic instrumentation. This cell, developed by Harwood Engineering Co., is a small pressure vessel for connection direct to high-pressure lines. A coil of manganin (copper-base alloy containing 12 per cent manganese and 4 per cent nickel) wire is sealed

Ideas





in a pressure-sensitive thimble assembly inside the cell with an electrically insulated lead brought through the cap of the vessel, the other lead being grounded to the coil body. This coil changes in electrical resistance in direct proportion to the pressure so that electronic instruments for indicating, recording or control may be employed for measuring the pressure. Use of such a coil as a secondary pressure measuring device was first successfully developed by Prof. Bridgman of Harvard University. The pressure-sensitive thimble utilized in the cell illustrated is a flexible bellows filled with a fluid which will not solidify under the pressures employed. Typical fluids are alcohol or acid-free kerosene. The stem part of the assembly carries high-pressure packings, both internally for the electrical lead and externally as shown in the photograph.



Tiny motor, left, employs molded transparent plastics for frame and end bells, making inexpensive light weight drive for toys. Built by Wilson's of Cleveland, the motor is simply cemented together to make a completely enclosed unit except for the shaft extensions. Brass bearings and phosphor-bronze motor brushes are molded in as inserts, the brushes extending through the case to provide terminals for connection to a battery. The field is an Alnico permanent magnet positioned in the frame by a small spring clip. Having a permanent-magnet field, the motor is reversed by merely changing the terminals. Designed to operate on one or two small flashlight batteries, the motor develops no-load speeds up to 10,000 rpm. Speed and current drain at no-load conditions for various voltages are indicated in the curves. A counterpart of this motor, but with a metal frame replacing the plastic, has recently been developed for industrial applications.

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Why Machine Parts Fail

Part 6–Torsional Fractures

APPEARANCE of a fatigue fracture caused by alternating torsion is quite different from those discussed and illustrated in Part 5 of this series for bending and axial failures. Typical torsional failures are shown in *Figs.* 51 through 55.

TWO KINDS OF TORSIONAL FAILURE: Torsional fatigue failures occur in one of two modes: along the planes of maximum shear or along the plane of maximum tension. The state of stress in a shaft subjected to a torsional load is diagrammed in *Fig.* 56*a*. Maximum shear stress occurs along the axis of the shaft and at right angles to it, while the maximum tensile stress acts at 45 degrees to the two shear stresses. Therefore, the two basic modes of torsional failure are: (1) longitudinal or transverse, along the planes of maximum shear; (2) helical, at 45 degrees to the shaft axis, along the plane of maximum tension. These basic types of failure are sketched in the first column of TABLE 3 and are shown in *Figs.* 51 through 55. *Figs.* 52 and 53 represent the shear failures, *Figs.* 51 54 and 55 the tensile failure. Fractures which depart in appearance from these basic modes may seem anomalous but can be readily explained when local stress distribution and material properties are taken into account.

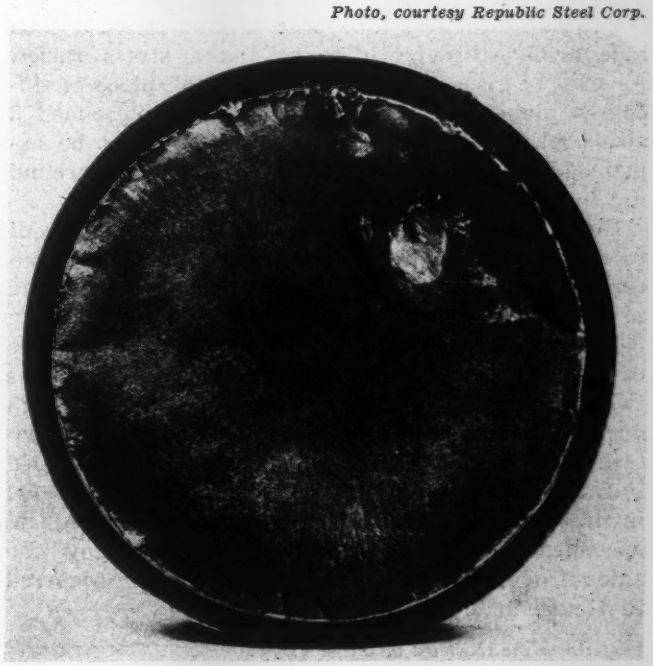
WHICH FAILURE TO EXPECT: It will be noted from *Fig.* 56*a* that in a shaft subjected to a torsional load the maximum shear stress is equal to the maximum tensile stress. However, the corresponding two strengths in steel are not equal, the shear strength being approximately one-half the tensile strength. Therefore, the shear stress will reach the shear strength long *before* the tensile stress will reach the tensile strength; shear-type failure will result. The reason that transverse cracks are more prevalent than longitudinal cracks is that grinding or machining marks, which accentuate the probability of failure, are oriented in the transvere direction.

When a stress concentration is present, such as a transverse hole in a shaft, it tends to cause a tensile fracture, that is, a crack at 45 degrees to the

Fig. 51—Top—Torsional fatigue failure of this helical spring occurred at 45 degrees to the wire axis. Fracture followed plane of maximum normal stress, an indication of brittle failure

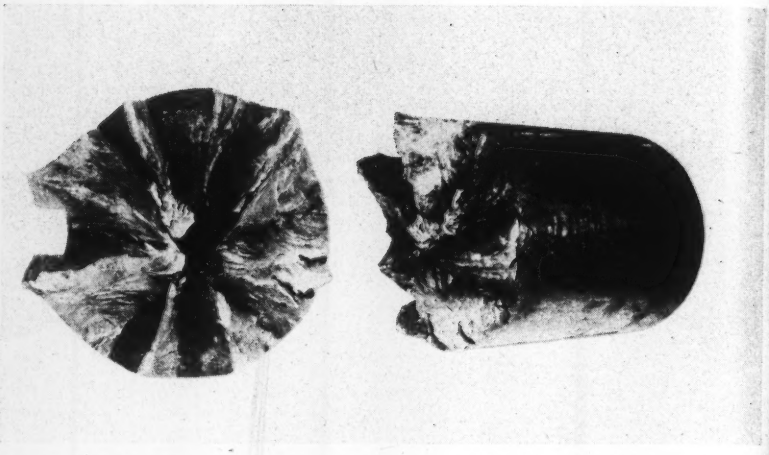
Fig. 52—Below—Surface of this torsional fatigue fracture has been rubbed smooth, a characteristic appearance of transverse failures

Photo, courtesy Republic Steel Corp.



Photo, courtesy Battelle Memorial Institute

Fig. 53—Left—Stress concentration led to this torsional failure which followed tool marks on orignal fracture plane, then shifted to a longitudinal plane and finally terminated on a second transverse plane



Photo, courtesy Armco Steel Corp.

Fig. 54—Above — Torsional fatigue fractures of this typical star shape are caused by the many points of origin of tensile failures on planes at 45 degrees to the longitudinal axis

axis of the shaft. This change in mode of failure is due to the changed stress distribution caused by the stress concentration, which is equivalent to a factor of four in the case of a transverse hole. The effect of this stress concentration is to raise the tensile stress to four times its normal value. The shear stress remains substantially the same. This altered relationship is illustrated in *Figs.* 56*b* and 56*c*.

Thus, although the tensile strength is still twice the shear strength the tensile stress is now four times the shear stress. Therefore, the tensile stress will reach the tensile strength long *before* the shear stress will reach the shear strength; a tensile (45-degree) type of fracture will result.

The foregoing concepts of torsional failure have been experimentally verified with hollow specimens by Smith[1], as shown in *Fig.* 57. Specimens 2 and 4, without stress concentration, failed in shear with a transverse fracture. Specimen 1 had a 0.012-inch hole drilled through it to act as a stress raiser. As may be seen, a tensile fracture took place on 45-degree planes. Though without a hole, Specimen 3 also broke in tension. This result could not be explained until heavy tool marks were discovered around the internal bore of the specimen.

Geometric stress raisers need not always be present to cause a helical tensile fracture. Internal discontinuities and flaws may act as sufficient stress raisers to magnify the tensile stress to the point where a helical fracture results. In *Fig.* 58 is shown a series of torsional failures.[2] Speciment *A*, Armco iron, was twisted to static torsional failure, showing the high ductility of the material. Specimen *D*, the same material tested under a fluctuating torsional load, failed in fatigue (brittle failure) in the expected transverse manner. Black longitudinal lines were placed on specimens *A* and *D* prior to testing to show the amount of deflection. Pronounced deflection occurred in *A*, none in *D*.

[1] References are tabulated at end of article.

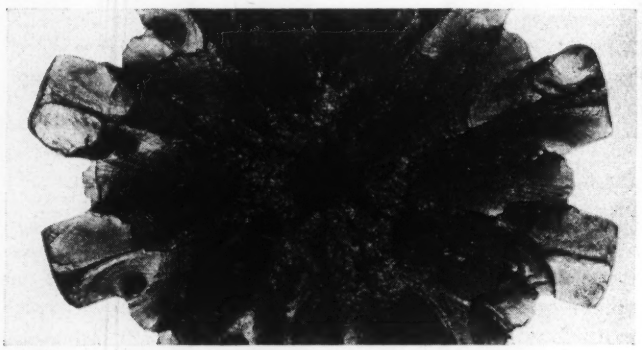


Fig. 55—Above—Torsional failures of splined shafts evidence this characteristic appearance. Stress concentrations at base of spline cause tension failures on 45-degree planes. Typical fracture is also diagrammed in Fig. 59

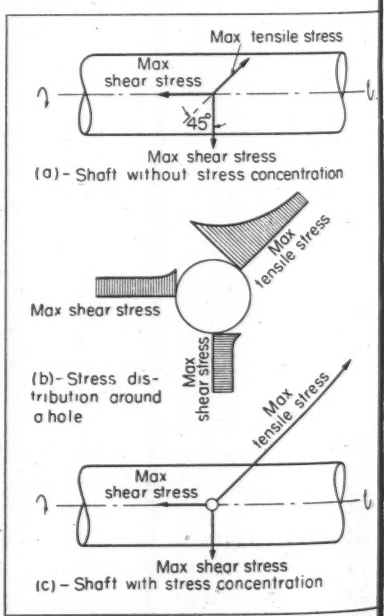


Fig. 56 — Right — Stress distribution in a torsionally-loaded shaft is greatly affected by stress concentrations. Without stress concentration (a), maximum tensile stress and maximum shear stress are equal. As shown at (b) and (c), however, transverse hole increases maximum tensile stress to four times maximum shear stress

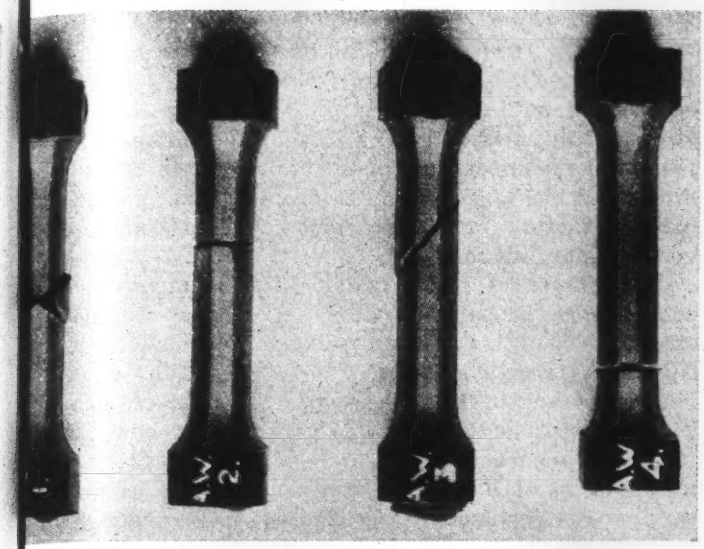


Fig. 57—Left—These hollow test specimens show the effect of stress concentration on torsional fracture. Specimens 2 and 4, without stress concentration, fractured transversely. Specimen 1, with a transverse hole, failed in a helical tensile fracture. Similar fracture occurred with Specimen 3 because of heavy tool marks in the bore

Specimens *B* and *C* had no stress raisers and presumably both should have failed in the planes of maximum shear, that is, transversely or longitudinally. Specimen *C*, mild steel, did fail in the expected manner, the primary fracture being longitudinal which then branched off in a 45-degree direction. Specimen *B*, high carbon steel, failed in the plane of maximum tension. This result is attributed to a stress raiser in the form of an internal inclusion on a microscopic scale.

SURFACE FINISH: Under fluctuating torsional loading the quality of surface finish is more important than under bending or axial loads. This is because tool marks, grinding marks and scratches are usually located at right angles or along the axis of the shaft, that is, along the planes of maximum shear stress (see *Fig.* 56). Although shear stress is over one-half

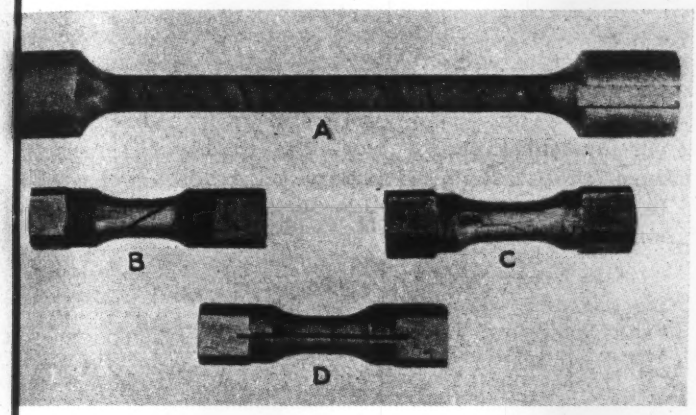
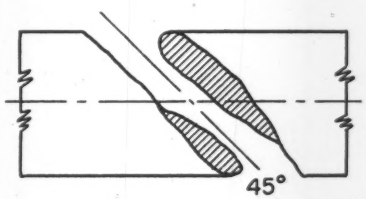
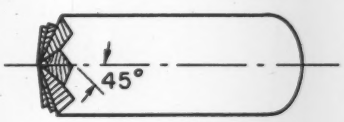
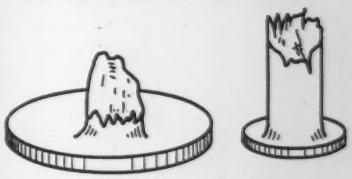
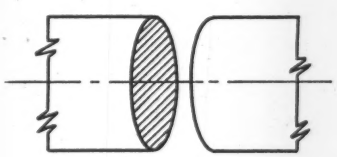
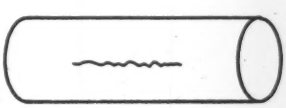
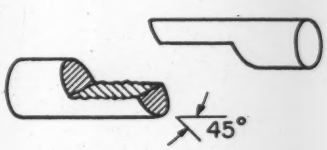
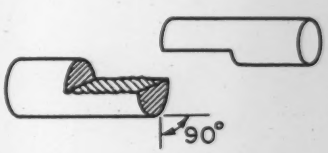


Fig. 58—Left—In this study by Gough, torsional failures were produced under static (A) and fluctuating loads (B, C and D). Transverse fractures of Specimens (A) and (D), Armco iron, and longitudinal fracture of (C), mild steel, were anticipated. Specimen (B), high-carbon steel, unexpectedly fractured helically from tensile failure because of a microscopic inclusion

Table 3—Typical Appearances of Torsional Fractures

Type of Failure	Basic Pattern	Variations of Basic Pattern (a)	Variations of Basic Pattern (b)
Tensile 1		Star pattern 	Saw tooth due to stress concentration at fillet 
Transverse Shear 2		Small step	Large step
Longitudinal Shear 3			

the tensile stress in bending or in direct tension the two stresses are equal in torsion. Because of this equality of stresses, a transverse tool mark is more dangerous in a part subjected to a torsional load than to bending. A fracture which followed a tool mark is shown in *Fig.* 53.

SPLINED SHAFTS: Splined shafts almost always produce a characteristic compound fracture. As illustrated in *Figs.* 55 and 59, fatigue cracks originate almost simultaneously at all the spline roots and grow at about the same rate until the remaining sound material at the center of the shaft ruptures instantly. The result is essentially a transverse fracture, occasionally exhibiting an approximately conical appearance.

HOLLOW SHAFTS: The inception of fatigue fractures in hollow shafts with no geometrical stress raisers is governed by the same laws as in solid shafts. The progress of the crack, however, is different in the two cases. In a hollow shaft the stress gradient is small, causing the fracture to be nearly transverse or, at the most, to have only a slightly helical course.

COMBINED TORSION AND BENDING: Many machine members are subjected simultaneously to significant stresses in both bending and torsion. The state of stress resulting from such a system of loading is reflected in the appearance of the fracture face. This is illustrated in *Fig.* 60 by the compound transverse and helical fracture of a shaft subjected to combined bending and torsion.

Crankshafts of reciprocating engines, pumps and compressors probably represent the most common examples of this type of loading. Crankshaft fractures are greatly affected by oil holes, fillet sizes, inherent crankshaft stiffness and the number, location and sizes of bearings. In many cases, however, it will be apparent from examination of the fracture which mode of loading was predominant in causing failure. For instance, if a crankshaft fails diagonally through one of the crankpins at the oil hole, torsional fatigue can be safely assumed. On the other hand, if the point of origin of the fatigue crack is observed at the fillet between the pin and the cheek and the crack started in the plane of the throw, failure is due to bending loads. If the crack started in a direction departing substantially from the plane of throw, failure can be attributed to torsional loads.

In the next article of this series failures arising from defective design will be discussed.

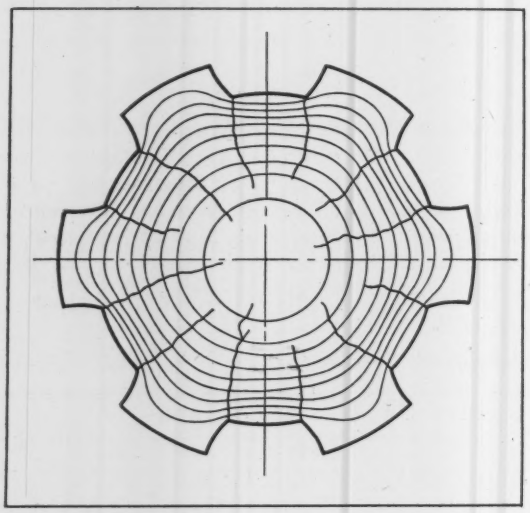


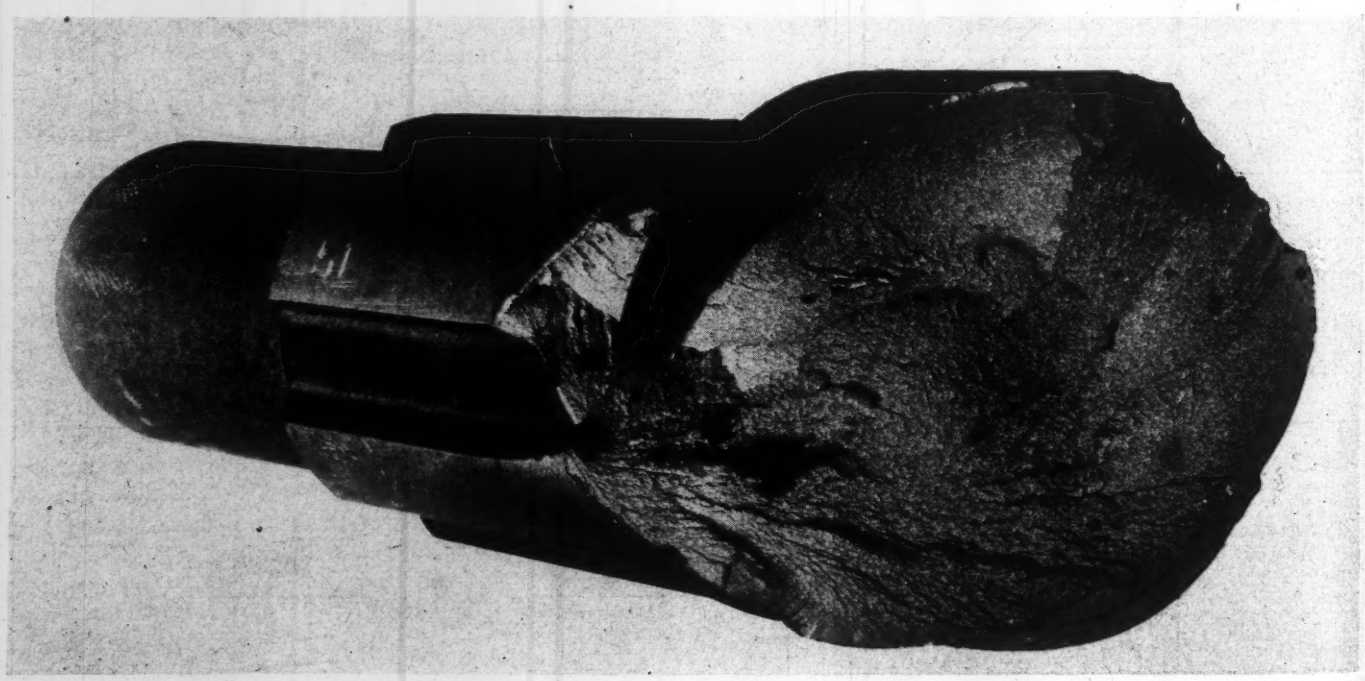
Fig. 59—Left—Course of torsional fracture in a splined shaft is diagrammed in this sketch. Note similarity to actual fracture illustrated in Fig. 55

REFERENCES

1. James O. Smith—*The Effect of Range of Stress on the Fatigue of Metals,* University of Illinois Bulletin, No. 334, Feb. 17, 1942.
2. Herbert J. Gough—*Fatigue of Metals,* Scott, Greenwood & Son, London, 1924.

Fig. 60—Below—Appearance of this fracture reveals that both bending and torsional loads contributed to failure

Photo, courtesy International Harvester Co.



Metal Ceramics

A new combination offering unusual properties not available in either material alone

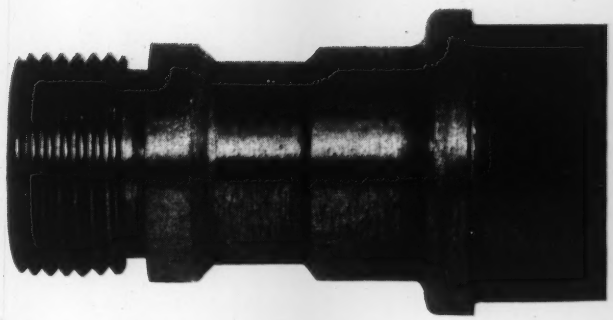
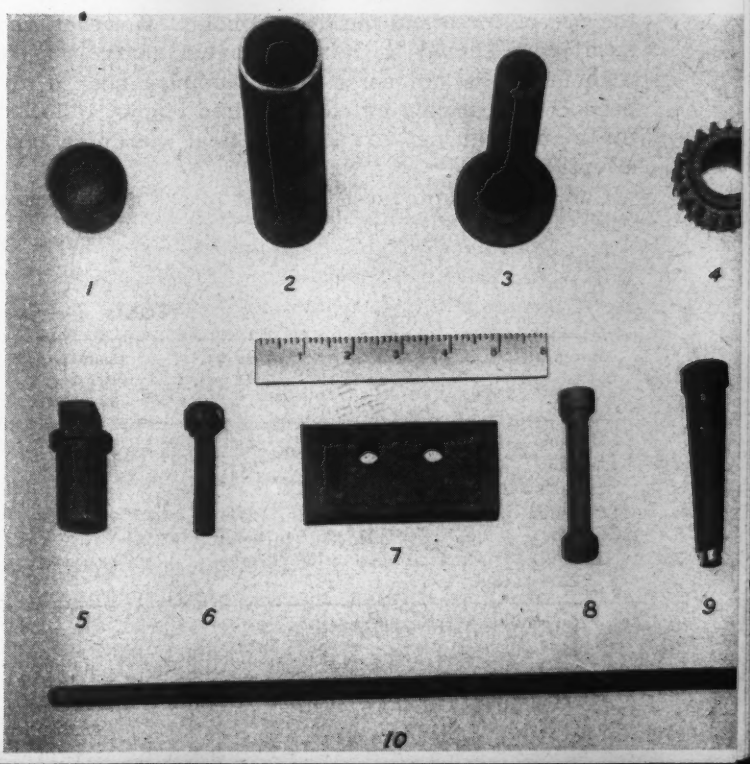


Fig. 1—Above—These parts have been center drilled, turned, threaded, milled, grooved and faced. On one part the threads have been machined and on the other they have been ground

Fig. 2—Below—Typical parts made from Metamic metal ceramics. (1) Crucible, 50 cc; (2) Combustion heater tube 1.5-in. OD by 5 in.; (3) High-intensity burner tip; (4) High-temperature rack and roller pinion; (5, 6) Bolts for high-temperature apparatus; (7) Deflection plate for molten slag; (8) Hot tensile test coupon; (9) Conical flame nozzle; (10) Hot gas sampling tube 14-in. long, with 0.020-in. orifice in hot end



METAL ceramics are a combination of pure oxide ceramics and a metal constituent, both of which have good high-temperature properties. They are usually fabricated by slip casting or powder-metallurgy techniques and machining, *Fig.* 1. Physical and chemical properties not available in either metals or ceramics alone are the practical result of this unusual combination.

These new metal ceramics are exceptionally strong and have excellent resistance to high temperatures and oxidation. The metal constituent is added to increase thermal conductivity and shock resistance. The ceramic constituent, which has a high melting point and is both nonductile and nonyielding, is added to increase resistance to deformation under high stress at high temperatures. It also affords the metal constituent additional protection from oxidation and from solution attack by molten steels.

Metamic LT-1 metal ceramic developed by the Haynes Stellite Division, Union Carbide and Carbon Corporation, has the following general properties: (1) Strength at high temperatures, short-time tensile strength tests show 17,500 psi at 1800 F to 3410 psi at 2400 F; (2) much greater thermal shock resistance than most ceramics; (3) resistance to oxidation in air at temperatures up to 2200 F; (4) resistance to combustion gases at temperatures up to 3100 F; and (5) resistance to attack by molten steel and furnace slag.

This material is strong, but it is brittle enough to break if dropped on a concrete floor. It is sensitive to thermal shock in the sense that small articles are apt to crack if heated rapidly or unevenly with a blowpipe flame, and large articles may crack if placed

in a hot furnace too rapidly. Metamic LT-1 is dull green or gray in the as-produced condition, and metallic looking when ground or machined. When failure is due to stress, the fracture is completely nonductile and appears finely crystalline and metallic. This is true except at temperatures over 2500 F, or under prolonged stress above 1800 F.

Properties of Metamic LT-1 as compared with those of high-fired sintered pure alumina (one of the best high-temperature ceramics), Stellite alloy No. 21, and cast iron are shown in TABLE 1. The mechanical properties are expressed in terms of bend strength (modulus of rupture) as in the ceramic industry.

DESIGN LIMITATIONS: Metal ceramics cannot be worked by rolling, forging, or drawing as now conventionally practiced. Since a certain amount of warpage is inherent when producing parts from these materials, limitations are imposed on the sizes, shapes, and tolerances that can be obtained at the present time. However, improved fabricating methods now being studied will, in time, ease these restrictions.

Present Limitations

Parts up to 2 inches in diameter by 18 inches long, or 3 inches in diameter by 3 inches long, can be produced with present equipment, *Fig.* 2. It is desirable to stay below a length-to-diameter ratio of 30 for rods and tubes, and under a length-to-thickness ratio of 30 for flat parts. For example: A rod with an 0.1-inch OD should not be longer than 3 inches; a rod with an 0.6-inch OD should not be longer than 18 inches; and a tube with an 0.5-inch OD and 0.25-inch ID should not be longer than 15 inches. With thin-walled tubes, it is desirable to stay under a diameter-to-wall thickness ratio of 8. For example: A sleeve 3 inches long with a 3-inch OD should have a $\frac{3}{8}$-inch wall thickness, and a tube 12 inches long with a 1-inch OD should have a $\frac{1}{8}$-inch wall thickness. It is difficult to produce parts having a wall thickness under 1/16-inch at present, regardless of other dimensions.

It is possible to produce very intricate shapes by the use of cores and multipiece molds. However, the usual care should be taken to avoid sharp corners without fillets. In some cases, complex shapes are produced by machining soft, prefired blanks, followed by a finish-firing to achieve final hardness and strength.

Camber in as-produced straight pieces may amount to 1/16-inch in a length of 8 inches, or to 3/16-inch in a length of 18 inches. Circular cross sections may be oval in shape to the extent that the minor diameter will be 5 per cent less than the major diameter. On plane surfaces, warpage or curling may be as much as 1/16-inch in 3 inches. Closer tolerances can be obtained by making the part oversize and finish grinding.

Inside diameter of tubes is usually produced by coring, and a taper of 0.002-inch (on diameter) per inch of length must be allowed for core withdrawal. It is not always possible to insure that the cores will be precisely centered.

Parts are usually produced with a nominal accuracy of plus or minus 2 per cent on the principal linear dimensions, except where this accuracy is made impossible by warpage or slightly nonuniform wall thickness.

JOINING: A number of techniques are available for joining parts to each other, to steels, or to alloys. These are:

1. Mechanical threaded joints. Bolts and screws of Metamic LT-1 can be made. These are relatively brittle, however, and are not suited for shock loading or stress concentrations
2. Pressure welding. This material can be pressure welded by standard oxyacetylene techniques. The joint should be upset slightly, as in the pressure welding of steel. Since Metamic LT-1 is nonductile, more care must be exercised when jigging articles made of this material than for jigging steel articles. However, small simple pieces can often be pressure welded in a bench vise with a hand blowpipe
3. Shrink-fitted joints. These can be designed for fairly heavy stresses
4. Copper brazing. This material can be copper brazed to steel by conventional hydrogen furnace procedures. It is not, however, readily wetted by silver solder.

MACHINING: Metal ceramics can be machined readily with tungsten carbide tools. If these are not available, high-speed steel tools may be used by reducing speeds, feeds, and depth of cut. Threads smaller than $\frac{1}{4}$-inch should be ground. Larger diameters can be machined or ground. Holes less than $\frac{1}{4}$-inch in diameter should not be tapped. Larger diameter holes can be tapped, using tungsten carbide or high-speed steel taps.

Table 1—Comparative Properties

Material	Density (lb/cu/in.)	Melt. Pt. (F)	Coeff. Exp. (Per deg. F 32-1832F)	Hardness (Rock. C)	Bending Str. (psi) 77F	Bending Str. (psi) 1832F	Bending Str. (psi) 2552F	Impact Str. (77F, in-lb)
Metamic	0.22	3362	0.0000047	35	50,000	38,000	15,000	11
Stellite (Alloy 21)	0.30	2547	0.0000080	30	*	*	Molten	200
Cast Iron	0.26–0.29	2066–2500	0.0000062	18–21	90,000	Oxidizes	Molten	73
Alumina (Pure sintered)	0.15	3722	0.0000043	Shatters	40,000	35,000	15,000	7

* Not suitable for ductile materials.

Automatic Dynamic Balancers

Part 2—Ring, Pendulum and Ball Balancers

By Ernest L. Thearle
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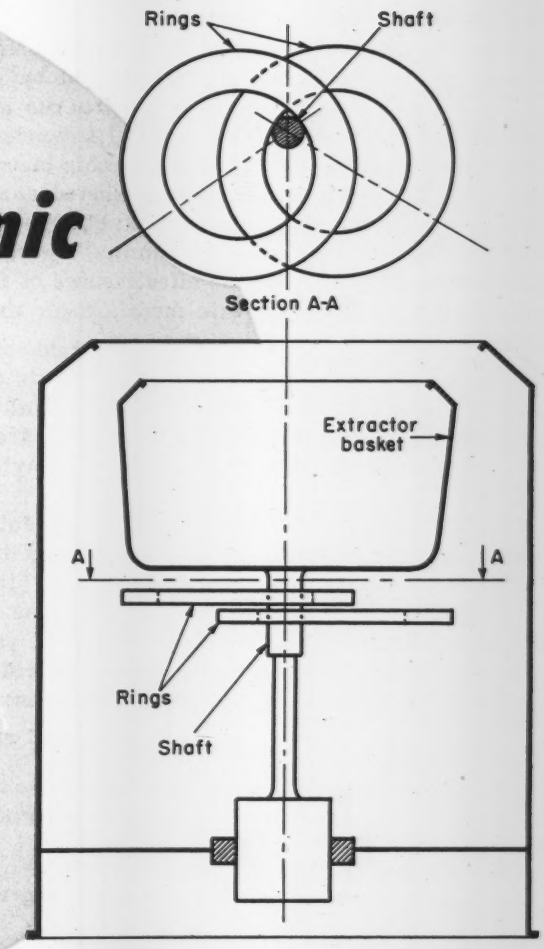

Fig. 9—Basic ring balancer. Casing, not shown here, encloses rings and contains liquid which damps their oscillations and aids in bringing them up to rotor speed

ATTEMPTS to achieve automatic dynamic balancing of centrifuges have produced three principal systems of a mechanical nature. Means of compensation employed in these arrangements are rings, pendulums and balls. The performance of each of these three systems will be analyzed in this article and checked against the requirements of the ideal balancer. These ideal characteristics were described in Part 1 of this series and compared there with properties of Leblanc-type balancers which employ liquid to compensate for unbalanced weight.

RING BALANCER: History of this device goes back at least as far as 1877 when Albert Fesca* suggested placing three loose rings on the shaft of a centrifugal machine. In 1916, Ledyard† showed a number of loose rings surrounding the bowl of a centrifuge. These devices are basically similar, although Ledyard placed the balance correction in or near the plane of unbalance.

Obviously, only two rings are necessary to compensate for any unbalance within the capacity of the device. The elements of such a balancer are shown diagrammatically in *Fig.* 9. Inasmuch as the two rings cannot lie in the same plane, a small couple is introduced. This couple, however, is negligible. The shaft upon which the rings bear must rotate with the basket. The rings are enclosed in a casing containing some liquid, such as oil, to damp out oscillations of the rings and to aid in bringing them up to rotor speed. This casing is designed of such a shape that the rings are held central at the lower speeds to maintain the device inactive at speeds below the critical. Such an arrangement prevents aggravation of the unbalance below critical speed when the system rotates with the "heavy side out."

Although the ring balancer is not effective over its entire speed range, it does offer a reasonable degree of balancing at speeds above the critical.

Possibly the most serious problem in the design of a ring balancer is the elimination of friction between the rings and their supporting surfaces. One attempt to eliminate this friction was recently made by mounting the rings on rubber supports. The elastic mountings, each attached to its ring and the

* United States Patent 125,036, Reissue 7455.
† United States Patent 1,183,745.

driving shaft, are intended to let the rings be displaced radially in the performance of their balancing function. Natural frequency of vibration of each rubber-mounted ring is made approximately equal to the critical speed of the rotating system.

However, internal friction in the rubber induces a ring to whip viciously at its natural frequency whenever the rotative speed is above this natural frequency. This whipping can be predicted analytically and has been observed experimentally. Because this disturbance persists at the running speed, rubber mountings detract from the effectiveness of the basic ring balancer, dooming this modification to failure.

PENDULUM BALANCER: The pendulum balancer[§], shown diagrammatically in *Fig.* 10, consists of a pair of disks mounted on the extractor shaft and carrying a number of pendulums. These pendulums are pivoted to the disks at a radius, r, greater than any expected eccentricity, e_1, of the extractor shaft.

In the upper view of *Fig.* 10 the pendulums are shown in the positions they assume when the rotor is running above its critical speed and the shaft in the plane of the balancer is whirling at a radius e_1 about the axis O. The center line of each pendulum will then pass through the axis of rotation, O.

In the following analysis, the notation is:

a = Distance of center of gravity of basket and load above center, Q, of elastic mounting
b = Distance of balancer above center, Q
e = Eccentricity of rotation of center of gravity of basket and load
e_1 = Eccentricity of rotation of balancer
e_o = Eccentricity of rotation of center of gravity of basket and load with no balancer
g = Acceleration due to gravity
k = Equivalent elastic stiffness of elastic mounting, as measured at center of gravity of basket and load
M = Weight of each balancer pendulum
q = Radius of rotation of unbalance weight
r = Radius from center of shaft to balance pendulum pivot
R = Radius of center of gravity of pendulum from pivot pin
w = Weight of unbalance
W = Weight of basket and load
α = Angle of reaction of pendulum on pivot pin
ρ = Radius of pivot pin of active balance pendulum from axis of rotation
ω = Angular velocity of rotating system
ω_c = Critical speed of rotating system.

Shown in *Fig.* 11*a* is a cross-section through the rotating system upon which are shown the actual forces acting on the system. These include the force exerted by each balance pendulum on its pivot pin, acting in the plane *A-A* of *Fig.* 10; the restoring force, ke, of the elastic mounting, acting in the plane *B-B;* and the force exerted on the basket by the unbalance, acting in the plane *B-B.*

In *Fig.* 11*b* is a similar cross-section showing the resultant of all forces acting on the basket and shaft. This resultant is shown acting at the center of gravity of the basket and load.

Because these systems of forces are equivalent, their moments may be equated. The resulting form is a moment equation inasmuch as these forces act in different planes.

Writing the equation of moments of forces about axis Q gives

$$a\frac{w}{g}q\omega^2 + ake + b\frac{M}{g}(R + r - e_1)\omega^2 - b\frac{M}{g}(R + r + e_1)\omega^2 - 2b\frac{M}{g}(R + \rho)\omega^2 \sin\alpha = a\frac{W}{g}e\omega^2 \quad (22)$$

This reduces to

$$\frac{W}{g}e\omega^2 + 2\frac{b}{a}\frac{M}{g}e_1\omega^2 + 2\frac{b}{a}\frac{M}{g}(R + \rho)\omega^2 \sin\alpha - ke = \frac{w}{g}q\omega^2 \quad (23)$$

From *Fig.* 11*a*

$$\sin\alpha = \frac{e_1}{\rho} \quad (24)$$

and from *Fig.* 10

$$e_1 = \frac{b}{a}e \quad (25)$$

Thus, Equation 23 becomes

$$\left[\frac{W}{g}\omega^2 + 2\left(\frac{b}{a}\right)^2\frac{M}{g}\omega^2 + 2\left(\frac{b}{a}\right)^2\frac{M}{g}\frac{(R + \rho)}{\rho}\omega^2 - k\right]e = \frac{w}{g}q\omega^2 \quad (26)$$

$$e = \frac{w q \omega^2}{\left[W + 2\left(\frac{b}{a}\right)^2 M\left(2 + \frac{R}{\rho}\right)\right]\omega^2 - k g} \quad (27)$$

Neglecting the weight of the disks which hold the pendulums, the eccentricity which would exist with no balancer is given by Equation 27 under the condition that $M = 0$, or

$$e_o = \frac{w q \omega^2}{W\omega^2 - k g} \quad (28)$$

Then, as shown in Part 1, Equation 15,

$$k g = W\omega_c^2 \quad (29)$$

Combining Equations 27 and 28 gives

$$\frac{e}{e_o} = \frac{W\omega^2 - k g}{\left[W + 2\left(\frac{b}{a}\right)^2 M\left(2 + \frac{R}{\rho}\right)\right]\omega^2 - k g} \quad (30)$$

Substituting Equation 29 and dividing by $W\omega_c^2$

$$\frac{e}{e_o} = \frac{\left(\frac{\omega}{\omega_c}\right)^2 - 1}{\left[1 + 2\left(\frac{b}{a}\right)^2\frac{M}{W}\left(2 + \frac{R}{\rho}\right)\right]\left(\frac{\omega}{\omega_c}\right)^2 - 1} \quad (31)$$

The effectiveness of the pendulum balancer may be predicted from Equation 31, making the rough

§ See United States Patent 2,405,404.

assumptions that $b/a = \frac{1}{2}$, $M = 20$ lb, $W = 40$ lb, $R/\rho = 2$, and ρ is never less than r. Substituting these values in Equation 31 shows that this device approaches an effectiveness of only about 50 per cent at the high speeds. Except for lowering the critical speed, an equivalent effect could be obtained by simply adding a 40-lb weight to the basket.

It is interesting to note that Equation 31 is quite similar in form to Equation 21 for the Leblanc balancer. Part 1, but that the pendulum balancer is not nearly as effective as the modified Leblanc balancer. Also, the pendulum balancer cannot very well be placed in the plane of the unbalance and is relatively costly to build.

Decreasing the radius, r, to zero simply reduces the device to the equivalent of the ring balancer with its attendant friction difficulties.

BALL BALANCER: About 20 years ago, the author constructed a dynamic balancing machine‡‡ in which the compensating element consists of two steel balls, contained in a cylindrical ball race. This arrangement greatly reduces the undesirable friction effect which is present in the ring balancer. In this application only two balls were used since it was desired to observe and measure their positions as an indication of the amount and position of the unbalance.

When this device is rotating above the critical speed and thus with the light side out," the balls experience forces tending to roll them in the race in such a direction as to decrease the total unbalance. Also, the only condition under which the balls are in stable equilibrium relative to the race is that of rotation of the race about its geometric axis. Thus, when the rotor is running above the critical speed, the balls automatically seek the correct positions to suppress oscillation of the shaft. The ball balancer is therefore 100 per cent effective above the critical speed and completely compensates for any unbalance within the limits of its capacity and sensitivity.

Maximum sensitivity of the device is realized when the unbalance is a minimum and the balls take up positions almost opposite each other. Minimum sensitivity is realized when the device is used at its full capacity and the balls are in contact with each other.

$$\text{Maximum Sensitivity} = \frac{1}{\mu\,(R-1)} \qquad (32)$$

$$\text{Minimum Sensitivity} = \frac{1}{\mu\,(R-1)^2} \qquad (33)$$

where μ = coefficient of rolling resistance of a ball on its race and R = ratio of race diameter to ball diameter. Sensitivity is here defined as the reciprocal of the radius of whirl of the race under the condition of impending ball motion.

It is interesting to note that the ring balancer is

‡‡ E. L. Thearle—"A New Type of Dynamic Balancing Machine," *Trans. ASME*, Vol. 54, 1932, Pages 131-141.

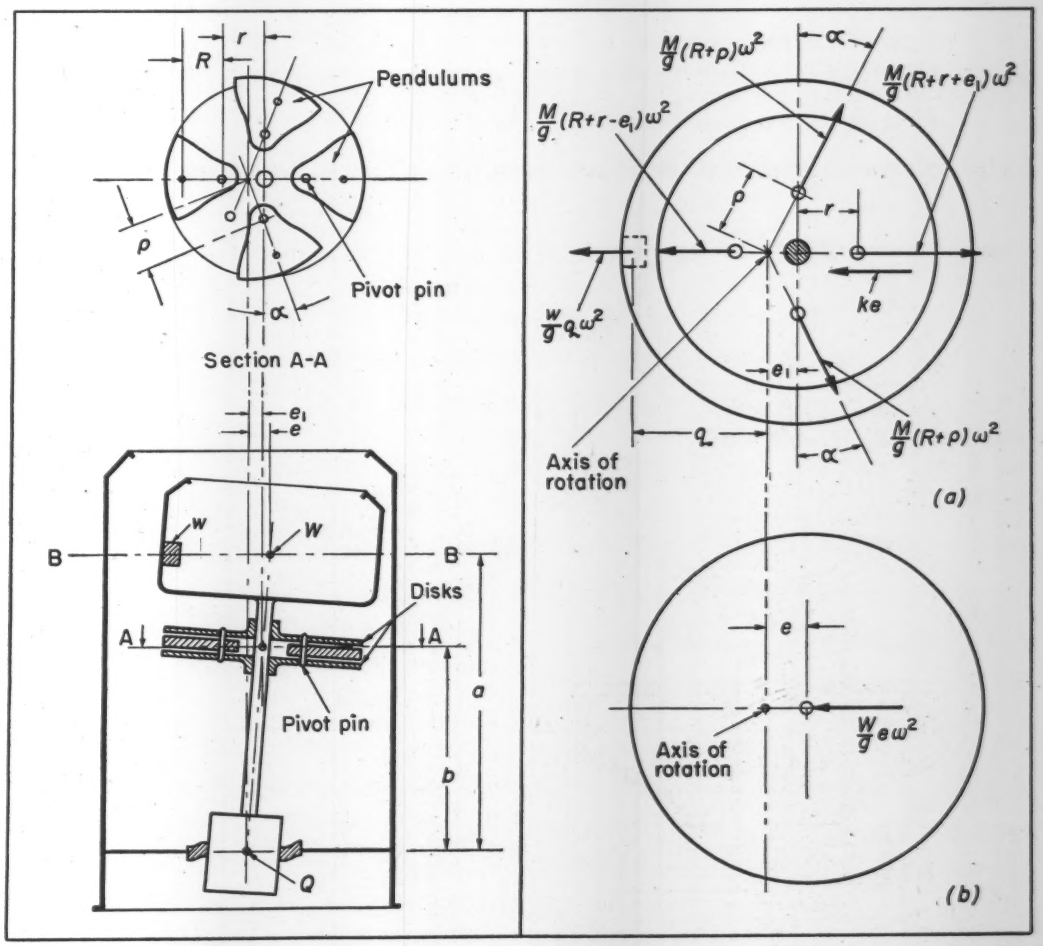

Fig. 10—Right—Pendulum balancer. Section A-A shows pendulums in positions they occupy when rotor is running above its critical speed

Fig. 11—Extreme right — Diagrams of force acting in pendulum balancer. At (a) are shown the actual forces exerted by the pendulums, the elastic mounting and the unbalance. At (b) is shown the resultant of all forces

a sort of "inversion" of the ball balancer. Equations 32 and 33 also apply to the ring balancer where R = ratio of shaft diameter to ring bore diameter.

The ball balancer does not lend itself very well to being placed in the plane of the unbalance in its application to a centrifugal extractor. It may, however, be placed directly beneath the extractor basket. Under this condition a horizontal reaction exists at the elastic mounting of the system, as shown in Part 1.

To increase capacity and sensitivity of the device more than two balls can be used. *Fig.* 12 shows the elements of a suggested design using six balls suitable for application to a centrifugal extractor with vertical shaft.

When the machine is at rest or operating at low speeds, the balls occupy the lower cavity where, closely packed, they introduce no additional unbalance at speeds below the critical. At some prechosen speed, somewhat above the critical and fixed by the angle β, the balls are thrown up the conical incline onto the outer race, as shown in *Fig.* 12, where they are free to take up the correct positions to compensate for the unbalance. The enclosing casing should contain some oil to cushion the motion and damp out any oscillation of the balls.

For the following analysis the notation is

a = Outside diameter of hub of balancer chamber
d = Diameter of a ball, inches
D = Diameter of ball race, inches
g = Acceleration due to gravity
N_o = Speed, rpm, at which balls leave inner cavity and become active
r = Radius to center of ball when in outer race
r_o = Radius to center of ball when in inner cavity
W = Weight of one ball
β = Angle of conical surface of inner cavity
ω_o = Speed, radians per second, at which balls leave inner cavity and become effective

In this design, it is assumed that

$$r_o = 1.05\ d \quad \ldots\ldots (34)$$

This allows some clearance between balls as they are packed in the inner cavity.

It is also arbitrarily assumed that

$$r = 2.5\ d \quad \ldots\ldots (35)$$

Then when the balls are all in contact in their active positions in the outer race, the condition of maximum capacity of the device, their centers of gravity will subtend an angle of about 113 degrees. These proportions result in a reasonably efficient use of the balls with high sensitivity and small diameter of casing.

In *Fig.* 13*a* a ball is shown in the inner cavity under the condition that it is about to leave this position, roll up the conical incline to the outer race and thus become active. This figure shows the actual forces on the ball: force of gravity, W, and normal force of the conical race on the ball.

In *Fig.* 13*b* the ball is shown under the same condition. This figure shows the resultant of all forces acting on the ball: product of its mass and its acceleration.

Because these systems of forces are equivalent, the sum of the components of forces shown in one figure, taken in any one direction, may be equated to that of the other figure. Summing components in the direction of the sloping surface of the cavity,

$$W \sin \beta = \frac{W}{g}\, r_o\, \omega_o^2 \cos \beta \quad \ldots\ldots (36)$$

or

$$\tan \beta = \frac{r_o\, \omega_o^2}{g} \quad \ldots\ldots (37)$$

(*Concluded on Page* 152)

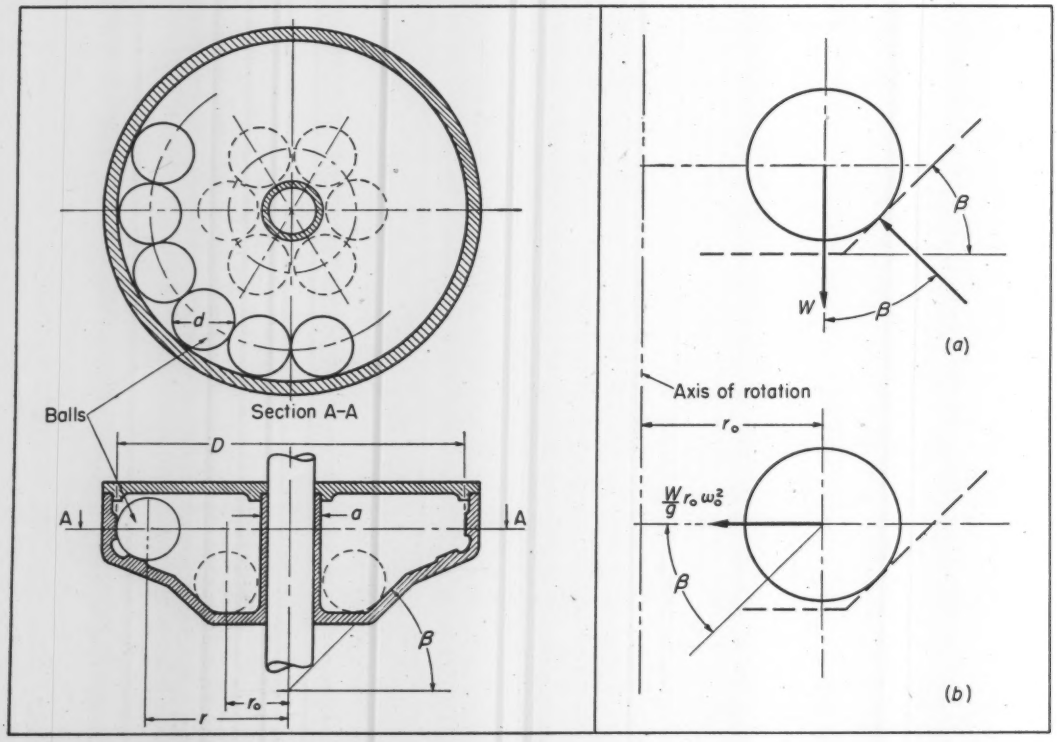

Fig. 12—Extreme left—Six-ball balancer. Balls occupy the lower cavity at speeds below the critical. At a prechosen speed above the critical, balls climb to the outer race where they position themselves to eliminate unbalance

Fig. 13 — Left — Force diagrams for balancer balls. At (a) are shown the actual forces exerted on a ball; at (b), the resultant of these forces

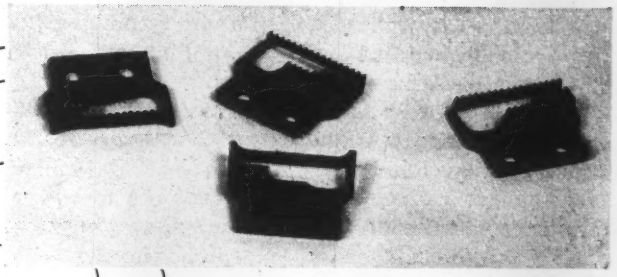

Fig. 1 — Left — Investment cast sewing machine feed dog produced to plus 0.006-inch, minus 0.004-inch

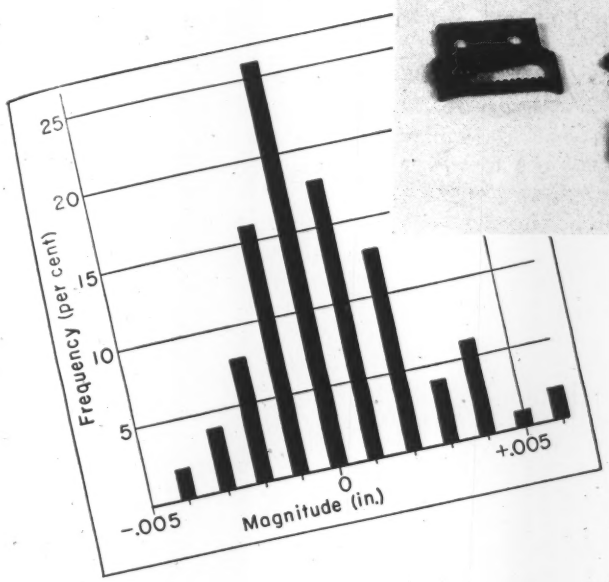

Fig. 2—Extreme Left—Frequency distribution of measurements on 100 feed dog castings shown in Fig. 1

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Tolerances for Investment Castings

INVESTMENT casting is a highly useful process, with a wide field of application, that makes possible important savings in production costs. The possibilities of the process, however, are not yet wholly realized. Until recently, investment castings have been used mainly as substitutes for machined parts. They have been used when the part had to be made of an alloy that was not readily machinable, or because the part could be produced by this method at a lower cost. While these conditions will continue to contribute to the growth of the industry, full realization of the potentialities of investment casting will be had only when parts are designed specially for production by this process. To justify this from an economical viewpoint, the important factor of practical tolerances must be considered:

Based on a paper presented at the ASTE 18th Annual Meeting and Exposition in Philadelphia, April 10-14, 1950.

Fig. 3 — Right Center — Small, compact castings of simple shape result in the least variations

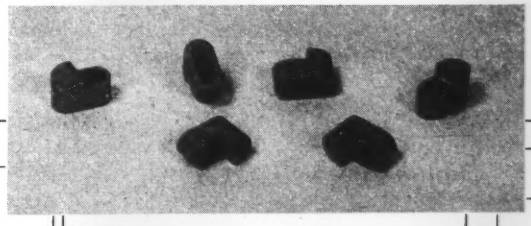


Fig. 5—Below—Results of dimensional check of 100 castings, Fig. 3, after removing defects

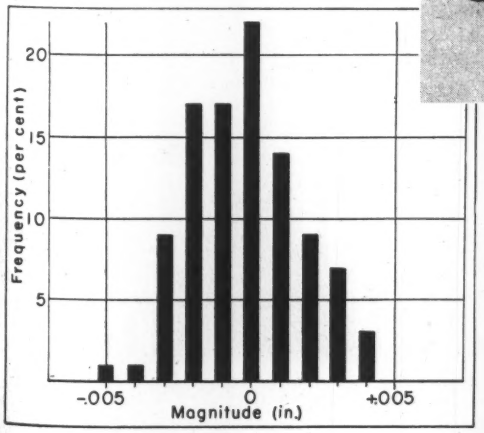
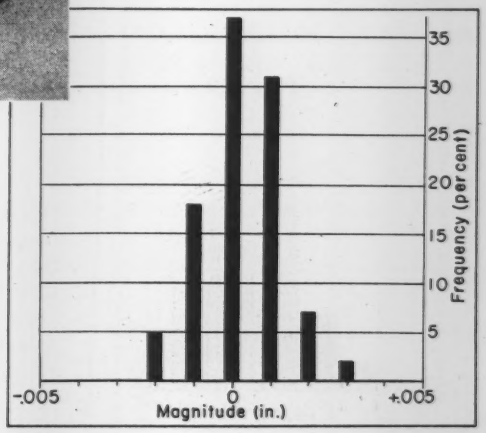


Fig. 4—Left — Dimensional variations found in production of parts shown in Fig. 3 above



TOLERANCES: Investment casting tolerances vary with sizes and shape. The pattern material is also a contributing factor. More uniform castings can be obtained with plastic patterns than with wax patterns. However, wax patterns are more economical for small-volume production, plastic patterns being amortized in runs of 5000 to 10,000 pieces or more. In general, as-cast tolerances of plus or minus 0.005-inch per inch of dimension can be held on dimensions up to 2 to 3 inches. Closer tolerances can be held on larger dimensions. A minimum tolerance of plus or minus 0.003-inch can be held on dimensions of ⅝-inch or less.

Distribution Studies Show Practical Ranges

A brief study has been made of the variations in dimensions of castings made from plastic patterns. A representative number of castings were checked and the results were plotted around the nominal casting size. Results obtained on a small, thin, flat casting, *Fig.* 1, used on a sewing machine are shown in *Fig.* 2. One hundred castings were checked and 97 per cent of the castings fell in a plus or minus 0.004-inch range, while 100 per cent fell in a plus 0.006-inch, minus 0.004-inch range.

A casting of compact shape will have less dimensional variation. This is due to the simplicity of its general shape, and relatively small length-to-thickness and length-to-width ratios. As an example, a small casting, ¾-inch long by ⅜-inch wide by ½-inch thick, *Fig.* 3, has the dimensional variations shown in *Fig.* 4. Ninety-five per cent of the castings fell within a 0.007-inch range. The high side of the graph is somewhat spread out. This is due to small positive defects of 0.001 or 0.002-inch in height.

A check was made on the ⅜-inch dimension (width) after 100 castings had been touched on a sand belt to remove the defects. No appreciable stock was removed from the castings. The distribution is more symmetrical, *Fig.* 5, having less distortion on the high side. All castings fell within a 0.006-inch range.

Another example is a ½-inch long casting, *Fig.* 6, with a thin cross section. Lugs at each end anchor the casting firmly in the mold, but the thin section is subject to warpage. Because of the overall length and high length-to-width ratio, there is a wider spread in the tolerance range than has been shown so far, *Fig.* 7. A great number of readings would show more even distribution, but enough data are present to illustrate the scattering of dimensions. A 0.040-inch range is held on all the castings while 95 per cent of them fall in a 0.020-inch range.

Machining type tolerances are not held, nor are they claimed. This formation, *Fig.* 7, shows typical casting ranges that are being held on production jobs and indicate how tolerance ranges can be established for noncritical dimensions. A 0.005-inch limit on the width of the feed dog castings, *Fig.* 1, for example, may be common practice on a machined dimension, but if there is no need for such a limit it should not be specified on the cast dimension.

Effect of Tolerances on Costs

How tolerances affect costs can be shown with an arbitrary casting dimension frequency distribution, *Fig.* 8. If plus or minus 0.003-inch limits are required, then 22 per cent of the castings are rejects. A low yield of satisfactory castings is obtained and the cost of 100 per cent dimensional check is involved. If plus or minus 0.005-inch limits are acceptable, then there are only 8 per cent rejects, although all the castings must still be checked dimensionally. The lowest cost is reached when plus or minus 0.010-inch limits are permissible. Then there are no rejects and it is necessary to make only spot checks, or statistical checks, on perhaps one per cent of the castings to insure holding the limits.

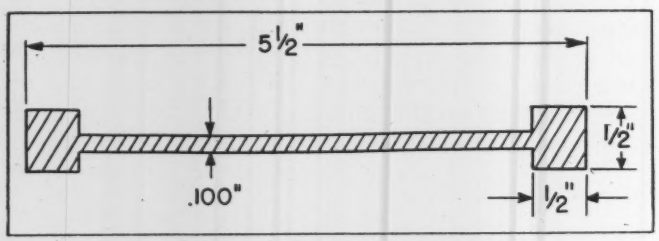


Fig. 6—Above—Long, thin-section design of casting results in some warpage

Fig. 7—Below—Distribution of dimensions for casting shown in Fig. 6. This frequency formation is typical of shop-run castings under average conditions

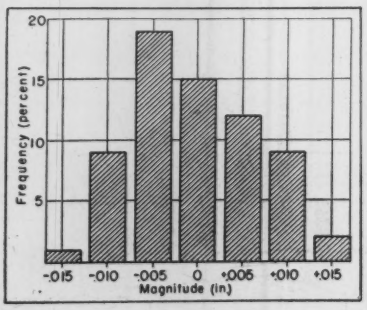
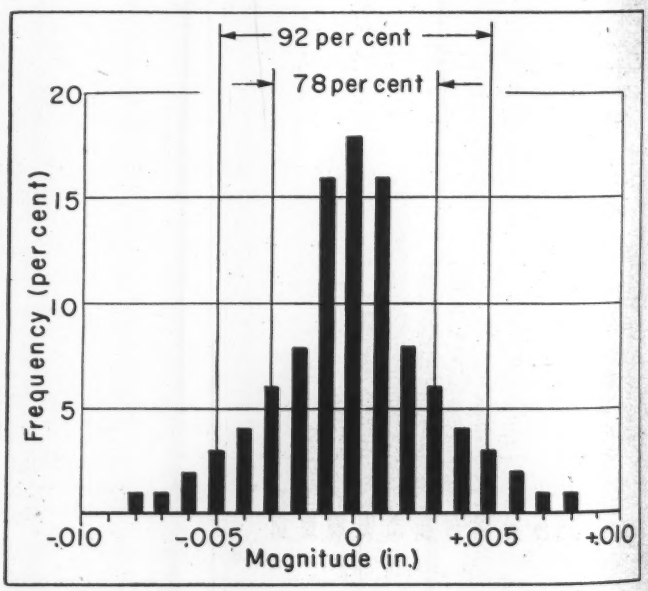
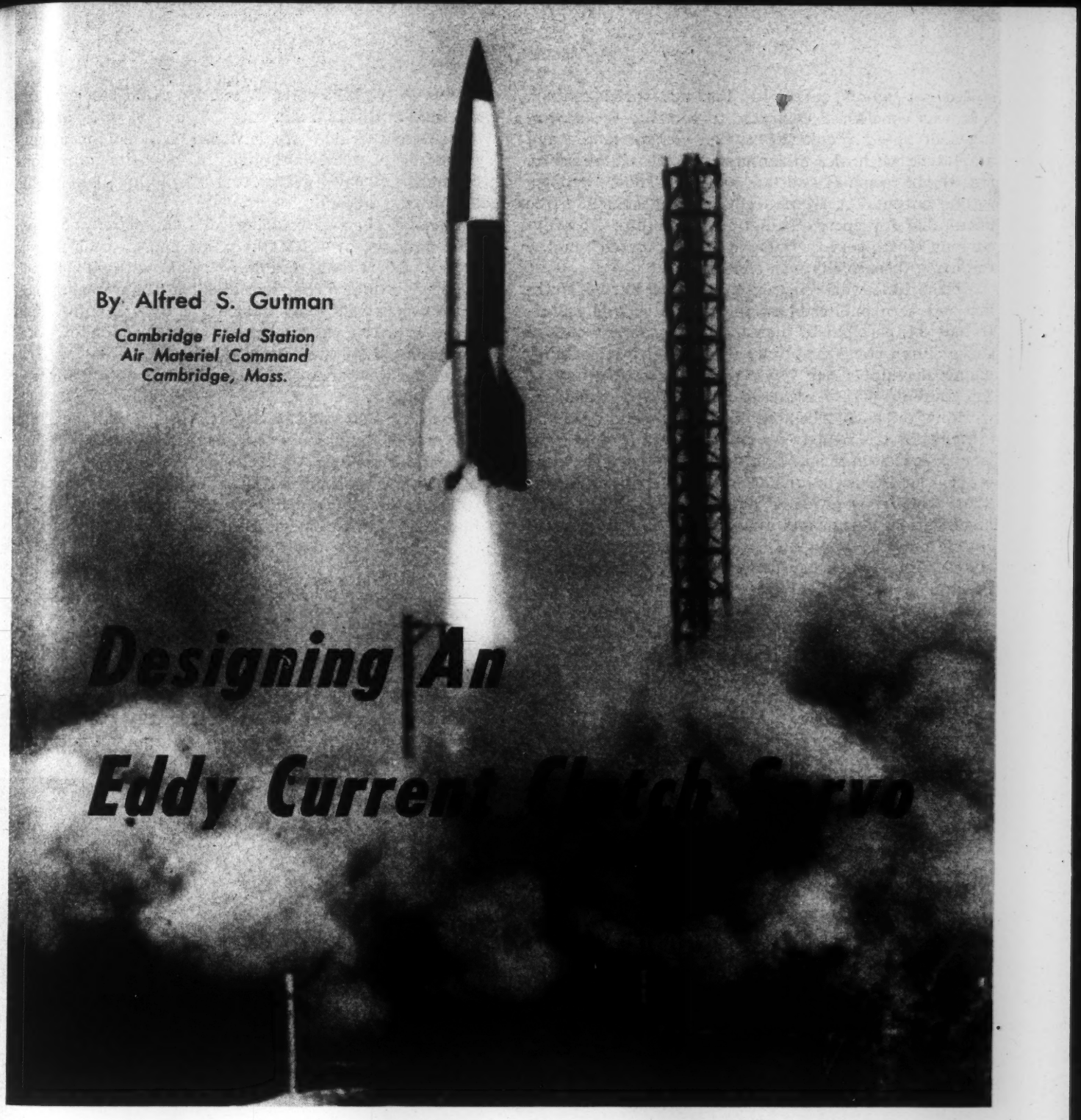


Fig. 8 — Hypothetical frequency distribution about the average dimension indicates how tolerances selected may affect shop costs





Designing An Eddy Current Clutch Servo

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Photo, courtesy North American Aviation Inc.

IN ATTEMPTING to design a stabilized reference platform inside the V-2 rocket, designers soon realized that existing servos, required for the platform control system, had severe limitations. The need was for a quick-acting, lightweight, powerful rotating servomotor which would allow speed regulation. An analysis of three existing types of rotating servomotors had revealed the following characteristics:

A *two-phase control motor* requires a large servo-amplifier because 50 per cent of the power output is controlled by the amplifier. Also, it has more inertia than the clutch-servo and is therefore slower in response. However, it provides a method of speed regulation.

An *amplidyne-fed d-c motor* requires bulky amplidyne equipment. It has more inertia than clutch-servos and is therefore slower in response, but it also permits speed regulation.

A *clutch-servo,* or electromagnetically activated friction clutch requires only small control current and a correspondingly small amplifier for torque output. It has low inertia and a quick response but is not well suited for speed regulation. Friction clutches are

suited for on-off operation, but not speed control.

It was considered desirable to combine the advantages of speed regulation of the control motor and amplidyne with the advantages of the clutch-servo, i. e., quick response and low control current for large torque output. A friction clutch is considered to be unsuitable for speed regulation; therefore, an eddy-current clutch-servo (referred to as "clutch" in the following discussion) was chosen.

At the time work on this clutch was started, nothing had been published on the magnetic fluid clutch. It may be possible to increase the torque of such a servo clutch considerably by use of high permeability magnetic fluid of the type developed by Rabinow of the Bureau of Standards. Several companies are working on such a clutch at the present time but difficulties are being encountered with keeping the iron particles in suspension, preventing deterioration of the fluid due to oxidation, properly sealing the fluid, which has abrasive qualities, etc. With some modification, design and analysis of the eddy current clutch may be applicable to such a magnetic fluid clutch. Experience has shown that the viscous drag in a magnetic fluid clutch is considerable and prevents high speed operation without execessive heat development. The latest design eddy current clutch, using a radial air gap and floating rotor assembly, permits a close air gap without maintaining unreasonable machining tolerances and therefore develops high torque without requiring a magnetic fluid.

BREADBOARD MODEL: In a preliminary model of the clutch, *Fig.* 1, two coils, C_1 and C_2, could be energized alternately through slip rings, S_1 and S_2 or S_3 and S_4. These coils, which are enclosed in a soft-iron container, *Fig.* 1, are rotated in opposite directions by means of bevel gears from a 1/20-hp, 10,000-rpm, 24-volt, d-c motor.

Between the two rotating coils and separated from the container by a 0.002-inch air gap on each side is a disk of soft iron, 0.040-inch thick, with 0.0005-inch copper plating. The flux lines of the rotating coil cut through this disk, inducing eddy currents which cause it to rotate, the speed and direction of rotation being regulated by the currents in the two rotating coils. Generally, only one of the two coils will be energized.

In the breadboard model, the use of ball bearings was ruled out because nonmagnetic bearings would have been required and the availability and quality of such ball bearings was questionable.

The preliminary eddy-current clutch-servo model had the following characteristics:

Weight of unit	4⅛ lb
Control field input	50 ma, 22 volts, 1 watt
Watt output	11.5 watts, 3000 to 6000 rpm
Stalled-torque	3 oz-in.
Inertia	0.08 oz-in.^{2}

These data compare very favorably with existing servo units. For instance, the C-1 automatic pilot uses a clutch-servomotor weighing 22¼ pounds and has a 33-pound-inch torque at 15 rpm. Under test

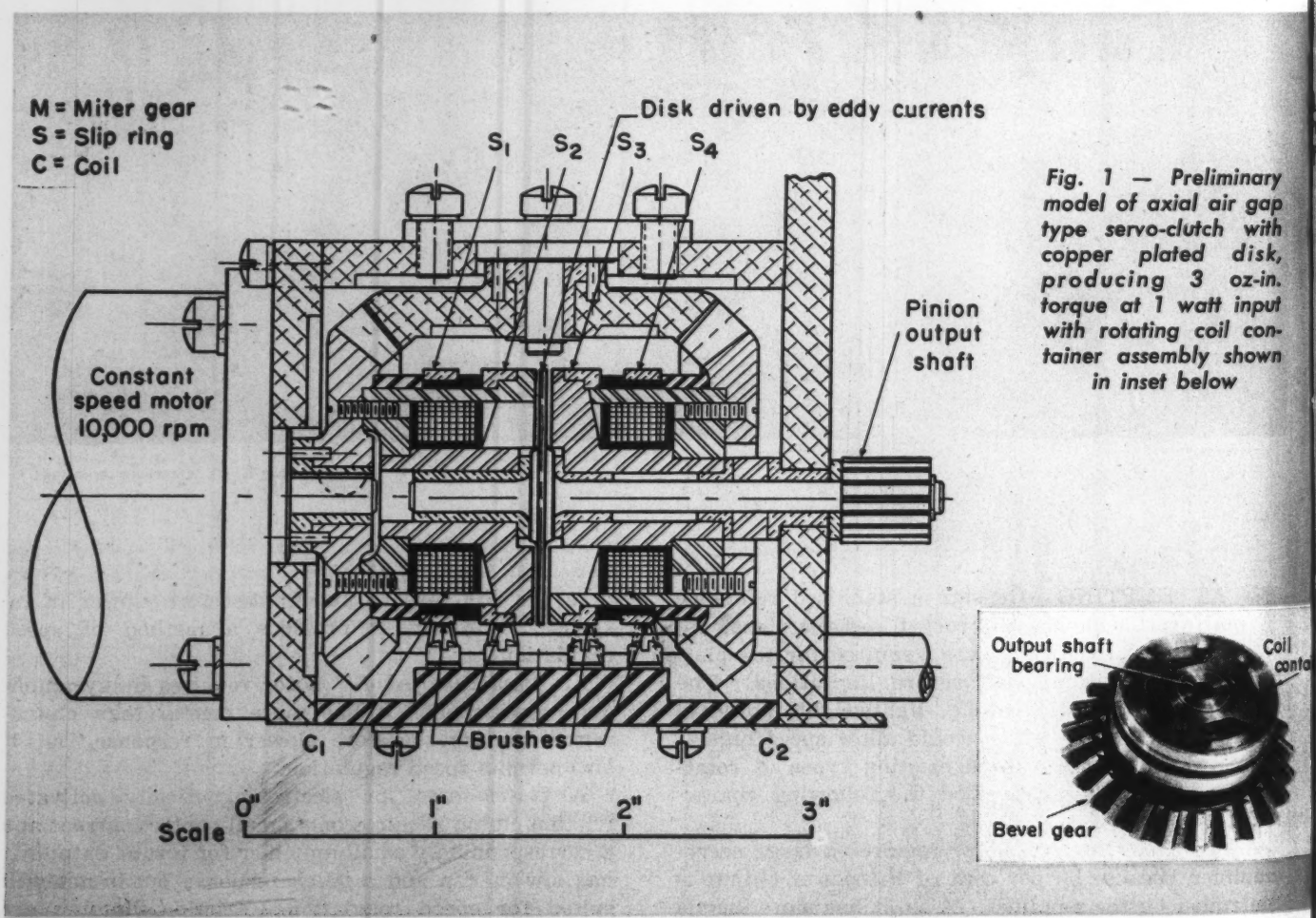


Fig. 1 — Preliminary model of axial air gap type servo-clutch with copper plated disk, producing 3 oz-in. torque at 1 watt input with rotating coil container assembly shown in inset below

with a suitable control amplifier, this preliminary servo was found to possess fast response and to permit speed regulation. Also, it is free of friction surfaces which might wear excessively. A new version with improved design of bearing mountings and gears, based on the results of the theory of operation to be discussed, has been built.

The improved unit has an average stalled torque of 20 oz-in. at 40 ma excitation. However, torque is also a function of angular position and tests show torque variations during one revolution from a small value up to 150 oz-in. maximum.

THEORY OF OPERATION: It was desired to establish a theoretical basis for the clutch in order to predict the power output and optimum design. In ordinary electrical machinery the current path is determined by wires and a coefficient of self-induction is used. In eddy current devices, however, where the path of the induced currents is unconfined, it is not possible to establish a constant coefficient of self-induction. Therefore, it is necessary to go back to Maxwell's fundamental equations of electromagnetics.

MAGNETIC FIELD AT ZERO SLIP CONDITION: Consider first the conditions in a stationary disk. Assuming that the disk radius is large in comparison with the pole distance, a good approximation is obtained by treating the disk as a plane strip under the poles, *Fig.* 2.

A theoretical analysis of a stationary disk of infinite thickness shows that

$$B_x{}^a = B_1 e^{-\alpha z} \sin \alpha x$$

$$B_z{}^a = B_1 e^{-\alpha z} \cos \alpha x$$

The assumption that $h = \infty$ is only slightly incorrect, as the attenuation inside the iron is large (varies exponentially); therefore, even a comparatively thin disk or strip has the same electromagnetic effect as an infinitely thick desk.

GENERAL EQUATIONS FOR ROTATING DISK: Having established the magnetic flux inside the strip for the stationary condition, *Fig.* 3*a*, there remains the more difficult task of finding the magnetic flux for the moving strip, *Fig.* 3*b*. If a conductor moves in a magnetic field, a current is induced in it, and this current creates a new magnetic field. In attacking the problem of the moving strip, the following approximations are assumed:

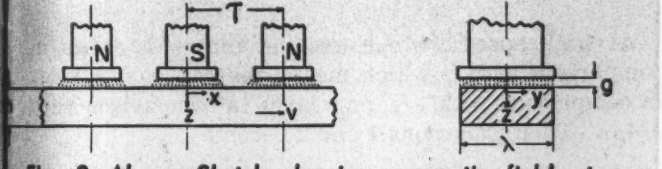
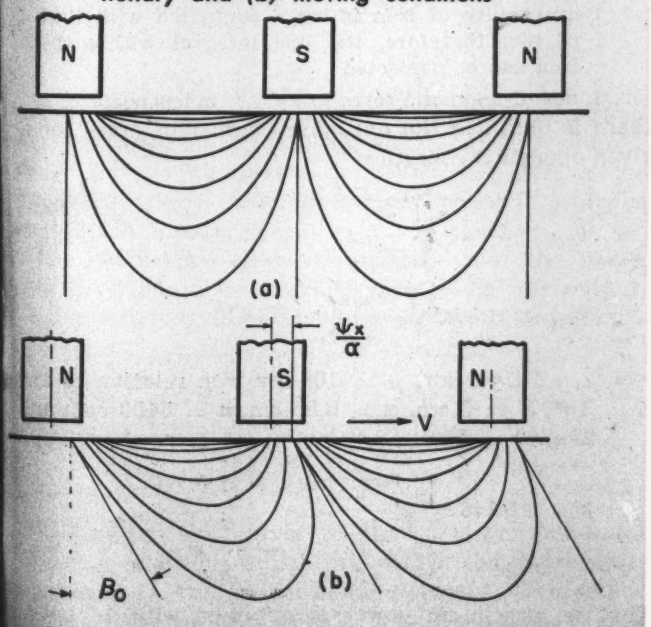


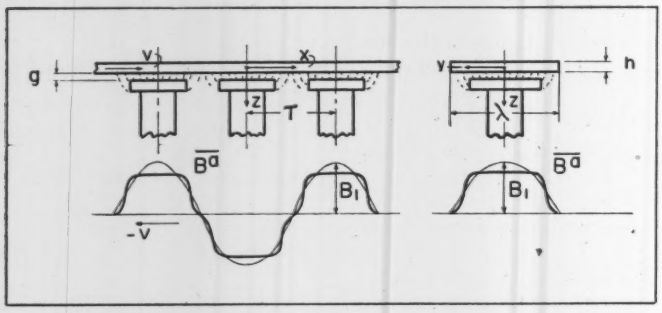
Fig. 2—Above—Sketch showing magnetic field at zero slip condition, with disk shown as plane strip

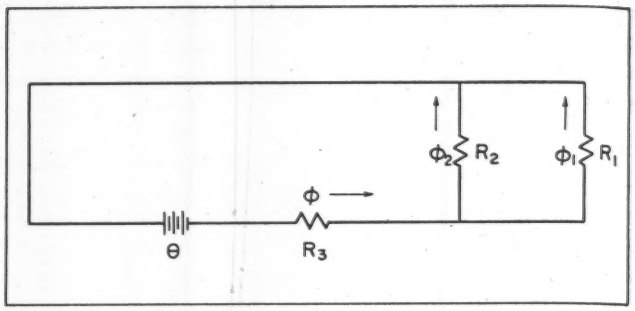
Fig. 3—Below—Magnetic lines of force for (a) stationary and (b) moving conditions



Nomenclature

B_1 = Magnetic flux of outside poles
B_a = Magnetic flux density caused by outside poles
$B_x{}^a$ = B_a component in X direction
$B_z{}^a$ = B_a component in Z direction
R = Radius of disk
R_1 = Reluctance between poles going through disk
R_2 = Reluctance between poles going through gap k
R_3 = Reluctance between poles going through iron core
R_0 = R_1 and R_2 in parallel
a = Thickness of pole shoe
g = Air gap between pole shoe and disk
h = Thickness of disk (or strip)
k = Air gap between adjacent poles
l = Length
n = Revolutions per minute
p = Number of poles
s = Specific resistance
v = Velocity of disk
x = Length measured in direction of X axis
y = Length measured in direction of Y axis
z = Length measured in direction of Z axis
$\alpha = \pi/\tau$
$\beta = \alpha x - \varepsilon z$
β_0 = Angle between neutral axis and Z axis = $\tan^{-1} \varepsilon/\alpha$
γ = Attenuation constant
ε = Refractive index
$\eta = 4\pi\mu\ v/s$
θ = Magnetomotive force produced by current in coil
λ = Length of pole shoe
μ = Permeability
μ_0 = Permeability of air = 1
τ = Distance between pole centers
ψ_y = Phase shift of currents
ψ_x = Phase shift of magnetic field in X direction
ψ_z = Phase shift of magnetic field in Z direction
ω = Angular velocity
ϕ = Total magnetic flux
ϕ_1 = Magnetic flux through disk
ϕ_2 = Magnetic flux through gap k





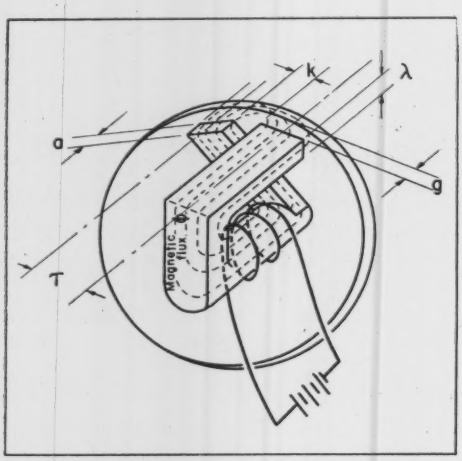
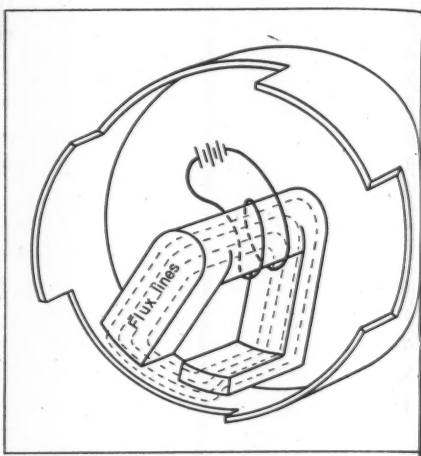


Fig. 4—Above, left—Fourier analysis of moving strip, considering only first sine term and omitting all higher harmonics

Fig. 5 — Left — Drawings showing magnetic flux lines through adjacent poles for axial gap type clutch

Fig. 6—Above, right—Equivalent circuit for Fig. 5

Fig. 7—Right—Simplified schematic drawing of two-pole radial air gap type eddy current clutch with floating sleeve which drives disk on output shaft



1. A plane strip is considered. This is permissible if radius, R, of disk is large in comparison to the pole distance
2. Any periodic function may be represented as a sum of sine or cosine functions (Fourier series); here only the first sine term is considered, all higher harmonics being omitted, *Fig.* 4
3. Length of pole shoe, λ, is assumed to be very large (to confine the problem to two dimensions)
4. Thickness of disk or strip, h, is large compared to penetration depth of magnetic flux and electric currents
5. Influence of temperature gradients is omitted
6. Permeability, μ, is considered constant at given operating conditions
7. Specific resistance, s, is considered constant at given operating conditions.

Theoretical calculations using these assumptions show that the phenomenon of the eddy current clutch is analagous to an electromagnetic wave which tries to propagate through the disk and experiences, inside the disk, a refraction and an attenuation. The attenuation constant is

$$\gamma = \sqrt{\frac{\alpha}{2}\sqrt{\eta^2 + \alpha^2} + \frac{\alpha^2}{2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where $\eta = 4\pi\mu v/s$. The refractive index is

$$\varepsilon = \sqrt{\frac{\alpha}{2}\sqrt{\eta^2 + \alpha^2} - \frac{\alpha^2}{2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

At high speed we can assume that η is large in comparison with α which means that $4\pi\mu v/s$ is large in comparison with π/τ, or v large in comparison with $s/4\mu\tau$. Then Equations 1 and 2 become

$$\gamma = \varepsilon = \sqrt{\frac{\alpha}{2}\eta} = \pi\sqrt{\frac{2\mu v}{\tau s}}$$

Making the approximations

1. Permeability of iron is large compared with that of air; therefore, the line integral within the iron can be neglected
2. Lines of magnetic force in air are independent of z

there is obtained the optimum number of poles for a given operation condition:

$$p_{opt} = 2\pi R\sqrt[3]{\frac{2}{\pi^3}(1+\sqrt{3.5})^2\frac{4\pi}{g^2}\frac{v}{s}\frac{\mu_0^2}{\mu}}$$

$$p_{opt} = 11.8\,R\sqrt[3]{\frac{R\,\omega\,\mu_0^2}{s\,\mu\,g^2}}$$

For $\mu_0 = 1$ for air, $\mu = 10^3$ for iron relative to air, $S = 10^4$, $R = 3$ cm, $g = 0.05$ cm, $n = 5400$ rpm and $\omega = 2\pi n/60 = 550$

$$p_{opt} = 0.118\,R\sqrt[3]{\frac{R\omega}{10\,g^2}}$$

$$= 14$$

That is, maximum power is obtained with 14 poles.

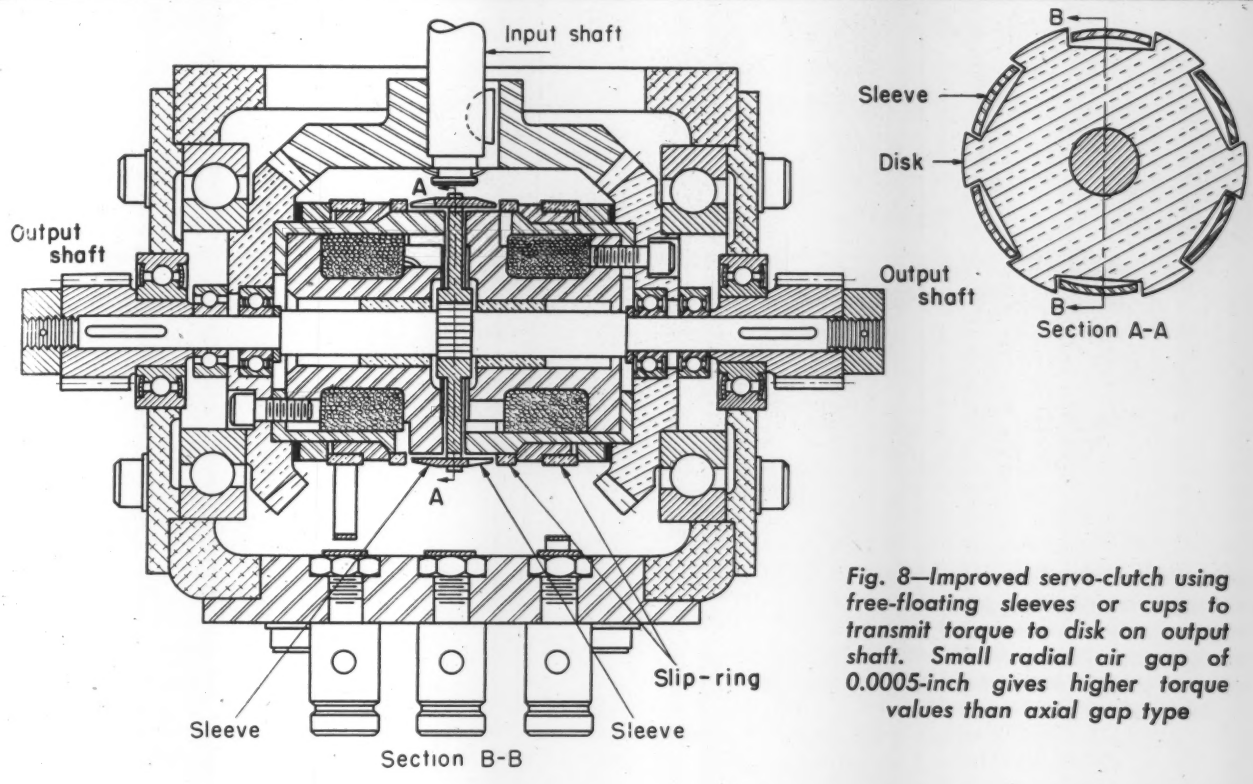


Fig. 8—Improved servo-clutch using free-floating sleeves or cups to transmit torque to disk on output shaft. Small radial air gap of 0.0005-inch gives higher torque values than axial gap type

A calculation of the magnetic fields shows:

$$\tan \beta_0 = \sqrt{\frac{2 \mu v \tau}{s}}$$

$$\tan \psi_z = \frac{1}{1 + \frac{\mu}{\mu_0} g \frac{\alpha^2}{\gamma}}$$

$$\psi_x + \frac{\pi}{4} = \psi_z = \psi_y$$

This relationship, which is independent of parameters, indicates that the phase shift angles, Ψ_z and Ψ_x, are physically significant quantities. A plot of the magnetic lines of force for the moving condition looks as shown in *Fig. 3b*.

The theoretical calculations show that the phase shift is intimately connected with the power output. Maximum power is obtained under the following conditions:

$$\psi_z = \psi_y = 8°26' \quad \ldots\ldots (4)$$

making

$$\psi_x = \psi_z - 45° = -36°34' \quad \ldots\ldots (5)$$

This phase shift gives maximum power under all physical conditions which are within the approximations used in this calculation. Actually, τ (distance between pole centers) may be kept fixed and v (disk velocity) varied. Or v may be held at a fixed value and τ altered. The magnitude of v must be comparable with

$$\frac{s g^2 \mu}{\tau^3 \mu_0^2}$$

or the magnitude of τ comparable with

$$\sqrt[3]{\frac{s g^2 \mu}{\mu_0^2}}$$

The calculations indicate that the stationary condition results in zero eddy currents and zero power. The extremely fast-moving strip ($v = \infty$) provides zero penetration of the magnetic lines and, therefore, zero power. This fast-moving strip generates eddy currents with allied magnetic fields, but these fields may be so much out of phase that their contribution to the transmitted power is small. At an operating condition of 8½ degrees phase shift in the Z-component of magnetic force, (Equations 4 and 5) the maximum effective power is transmitted.

CALCULATION OF OPTIMUM SPACING BETWEEN ADJACENT POLES: The final design consideration is the optimum air gap, k, between adjacent poles. If k is made very small, the magnetic flux will go through this gap instead of the disk, and the power will be reduced accordingly. If k is large, the size of the poles will be reduced, for a given distance between pole centers, τ, and the reluctance of the magnetic path increased correspondingly. This will reduce the

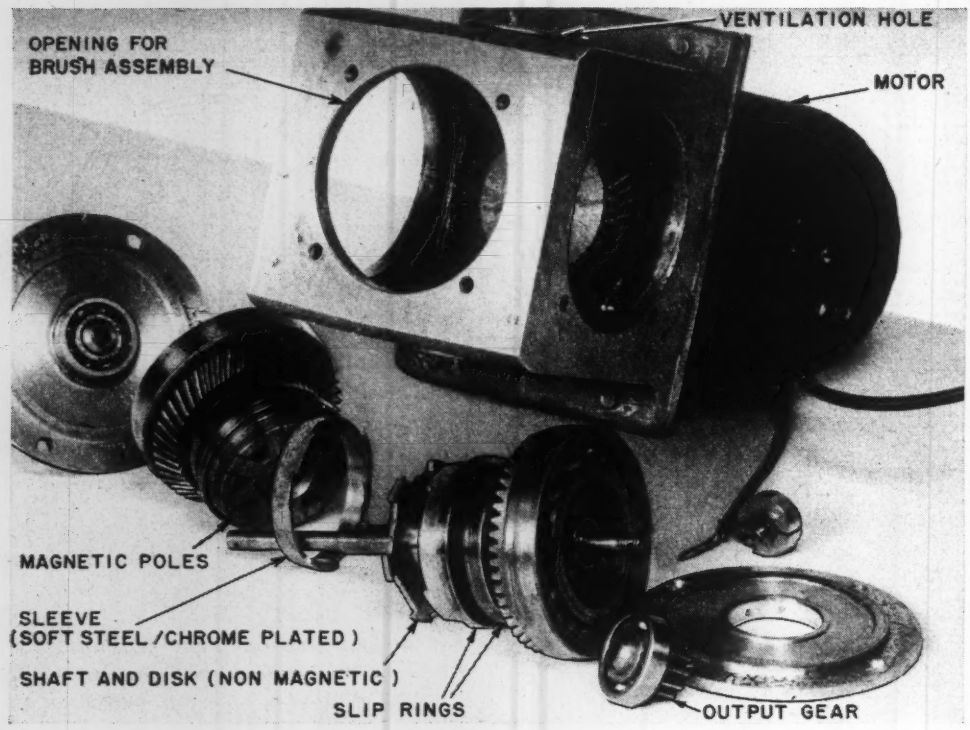
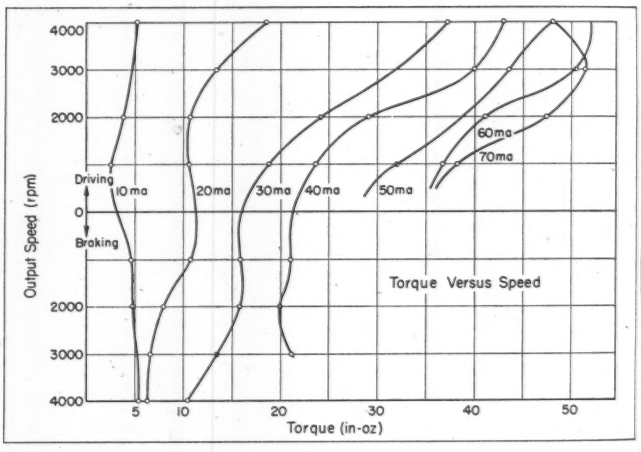


Fig. 9 — Left — Disassembled view of radial air gap clutch showing sleeve and disk construction. Sleeves are soft steel, chrome plated; nonmagnetic disk and output shaft are bronze

Fig. 10 — Below — Curves of torque versus speed, at various excitation currents, for radial gap eddy current clutch with chromium-plated driving sleeves



total flux through the disk at a given magnetomotive force. *Fig.* 5 better illustrates the magnetic flux.

The equivalent circuit for *Fig.* 5 is given in *Fig.* 6. Magnetic flux relationships are

$$\phi = \phi_1 + \phi_2$$

$$\frac{\phi_1}{\phi_2} = \frac{R_2}{R_1}$$

Reluctances are given by

$$R_1 = \frac{2g}{(\tau - k)\,\lambda\,\mu_0}$$

$$R_2 = \frac{k}{\lambda\,\mu_0 a}$$

But the total reluctance of R_1 and R_2, which are in parallel, is

$$R_0 = \frac{R_1 R_2}{R_1 + R_2}$$

Therefore

$$\phi = \frac{\theta}{R_3 + \dfrac{R_1 R_2}{R_1 + R_2}} = \phi_1 + \phi_2 = \phi_1 \left(1 + \frac{R_1}{R_2}\right)$$

$$\phi_1 = \frac{\theta}{\dfrac{R_1 + R_2}{R_2}\left(R_3 + \dfrac{R_1 R_2}{R_1 + R_2}\right)} = \frac{\theta}{\dfrac{R_3}{R_2}(R_1 + R_2) + R_1}$$

Assuming that $R_3 = R_1/1000$

$$\frac{R_3}{R_2} = \frac{1}{1000}\,\frac{2\,g\,a}{(\tau - k)\,k}$$

$$\phi_1 = \frac{\theta}{\dfrac{2\,g\,a}{1000\,(\tau - k)k}\,\dfrac{1}{\lambda\,\mu_0}\left(\dfrac{2g}{\tau - k} + \dfrac{k}{a}\right) + \dfrac{2g}{(\tau - k)\,\lambda\,\mu_0}}$$

$$\phi_1 = \frac{1000\,\theta\lambda\mu_0\,(\tau - k)^2\,a\,k}{(2ga)^2 + 2gak\,(\tau - k) + 2ga\,(\tau - k)\,1000\,k}$$

$$\phi_1 \propto \frac{k\,(\tau - k)^2}{2ga + (\tau - k)\,k + (\tau - k)\,1000k}$$

$$= \frac{k\tau^2 + k^3 - 2k^2\tau}{2ga + 1001k\,(\tau - k)}$$

Differentiating with respect to k and equating to zero for maximum,

$$(k\tau^2 + k^3 + 2k^2\tau)\,[1001\,(\tau - 2k)] = (\tau^2 + 3k^2 + 4k\tau)\,[2ga + 1001\,k\,(\tau - k)]$$

or

$$1001\,k^4 - 2002\,k^3\tau + (1001\,\tau^2 - 6\,ga)\,k^2 + 8ga\tau k - 2gak^2 = 0$$

With $g = 0.05$ cm and $a = 0.6$ cm, then

$$k^4 - 2\tau k^3 + (\tau^2 - 0.00018)\,k^2 + 2.4 \times 10^{-4}\,\tau k - 0.6 \times 10^{-4}\,\tau^2 = 0$$

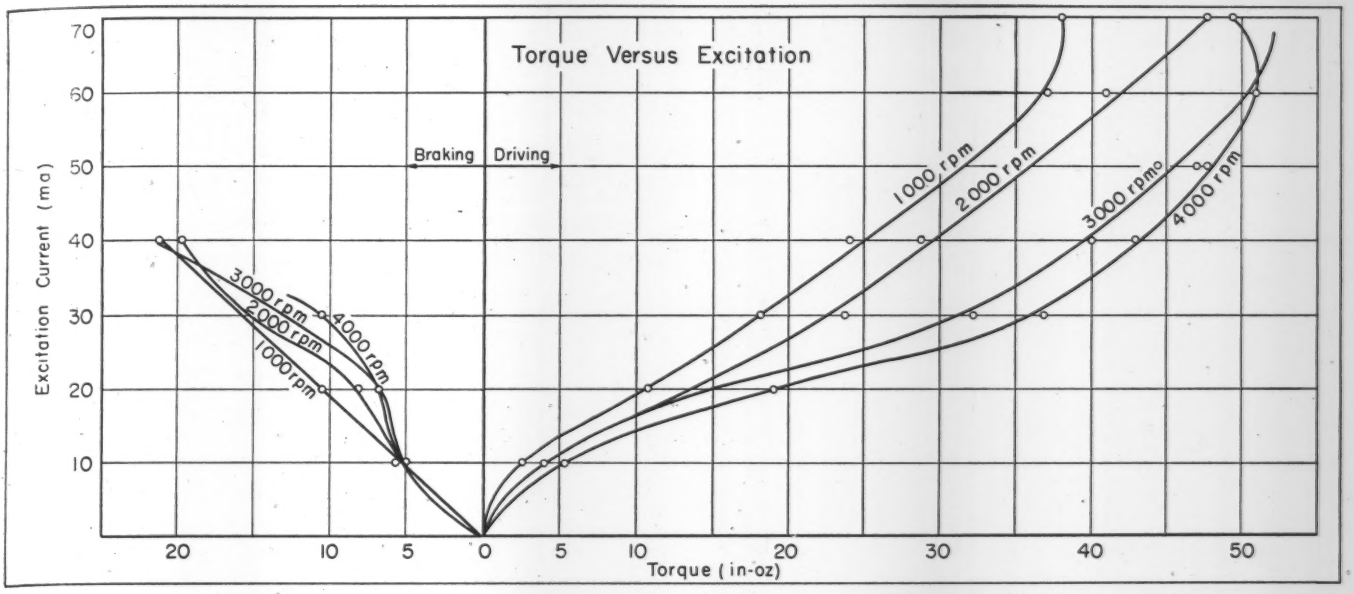


Fig. 11—Torque versus excitation curves at various driving speeds. For speed difference within clutch, subtract motor speed (5800 rpm nominal) from output speed taken from the curves. For speed differential in clutch, add motor speed (5800 rpm nominal) to output speed from the curves

This equation has four roots for k. If τ^2 is large compared with 0.00018, there are two comparatively large roots of the approximate equation

$$k^2 - 2\tau k + \tau^2 = 0$$

$$(k - \tau)^2 = 0$$

$$k = \pm \tau$$

These roots represent minimums and consequently are of no interest. The two other roots are very small; they are derived, therefore, approximately from

$$\tau^2 k^2 + 2.4 \times 10^{-4}\,\tau k - 0.6 \times 10^{-4}\,\tau^2 = 0$$

$$k^2 + 2.4 \times 10^{-4}\,k\tau^{-1} - 0.6 \times 10^{-4} = 0$$

$$k \approx -\frac{1.2 \times 10^{-4}}{\tau} \pm \sqrt{0.6 \times 10^{-4}}$$

$$= \pm 0.8 \times 10^{-2} - \frac{1.2 \times 10^{-4}}{\tau}$$

For $\tau \approx 1$,

$$k \approx 0.8 \times 10^{-2}\text{ cm} \approx 0.1\text{ mm}$$

Based on these calculations the unit was redesigned. Using a nonmagnetic stainless steel shaft with a soft iron disk pressed on and spun over the ends of a knurled hub, it was possible to utilize ball bearings.

Test results from the redesigned disk type eddy-current clutch were as follows:

1. Stalled torque approximately linear with excitation current in the region from 0 to 45 ma. The torque at 45 ma is 12 oz-in. It stays at this value up to 70 ma excitation current
2. Running torque at speeds from 2500 to 4500 rpm is zero up to 20 ma excitation current. Builds up to 22 oz-in. at 30 ma excitation current and stays at this value up to 70 ma excitation current
3. After several hours operation under load, the clutch changes its characteristics due to a slight change in air gap.

Although the clutch has worked out well under light loading conditions, such as on the inertia wheel (see MACHINE DESIGN, Feb. 1949, Page 83), it was concluded that this design was inadequate for heavier working conditions.

Difficulties were experienced with this unit due to axial play in the ball bearings. The problem of tolerances has been solved by assemblying the whole unit on the shaft and preloading the ball bearings by split nuts which are clamped together after proper adjustment. A beveled snap ring takes care of variations in the fit in the aluminum housing. Sleeve bearings have been completely omitted and lubrication holes for ball bearings have been provided through the shaft. Spiral miter gears are employed, the teeth of which also act as a centrifugal fan, drawing air in at the middle and blowing it out at the ends. Also, the input shaft was changed to drive what had previously been the idler bevel gear, with the output shaft extending out both sides of the unit.

The preceding theoretical treatment is applicable to both axial and radial air gap type clutches. The difficulties of making and maintaining the proper gap between the rotating disk and the magnetic coil have resulted in a design change from an axial to a radiant air gap. An axial gap depends on thrust bearings and is therefore more subject to change due to wear and tear than the radial type, *Fig.* 7, which depends on the machined tolerance between two diameters. Also, experience has shown that the torque developed by the latter type is larger due to the possibility of maintaining closer air gaps.

This design change is quite simple, *Figs.* 8 and 9. Instead of driving the disk, a drum cup or sleeve is driven with the drum connected to the disk. The new disk is nonmagnetic material (bronze) and the drum is magnetic material. In order to maintain a close radial air gap (0.0005-in) which gives high torque values, and to take care of eccentricities between the two coil housings and the central

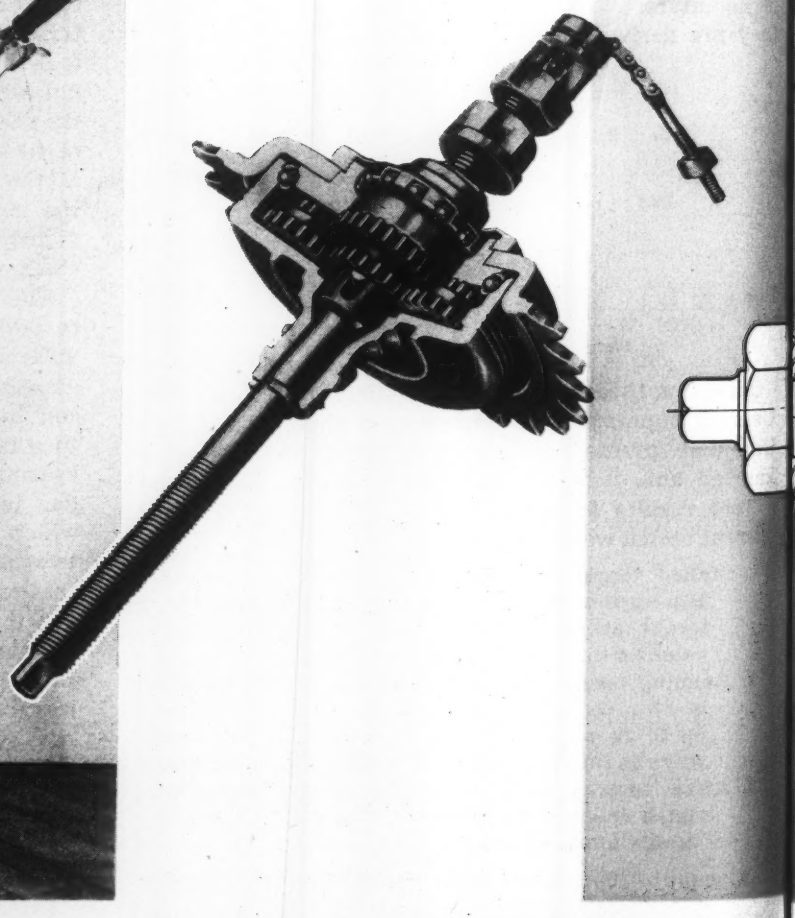
(*Concluded on Page* 154)

Contempora

Planetary Bicycle T

PLANETARY gearing in the bicycle transmission, below, permits three speeds while retaining the desirable back-pedalling coaster brake feature. Gear changes in the unit, made by New Departure Div. of General Motors Corp., provide for 25 per cent reduction from normal gear and 33 1/3 per cent increase from normal gear. The Triplspeed unit, photograph and drawing center and right, consists of a sprocket driven by the chain, a planet gear carrier to which the sprocket is attached, four compound or stepped planet gears journaled on the planet gear carrier studs, a ring gear in which the teeth of the larger planet gear are constantly meshed, a sliding sun gear, a larger supplementary sun gear, and an axle to which an axle cone is fixed.

In low gear, the sun gear rotates freely on the axle sleeve. One set of sun gear teeth mesh with the large planet and the other set of sun gear teeth engages the supplementary sun gear whose outer teeth mesh with the smaller planet gear. Since it is impossible for the stepped planet gear to revolve about sun gears of unequal diameters, the mechanism is locked and is driven as a unit about the axle, resulting in direct drive or low gear. When the sliding sun gear is moved to the right, it unclutches from the supplementary sun gear and immediately engages the internal teeth of the fixed axle cone. The sun gear thus becomes stationary, allowing the large planet gear to revolve about the sun gear and causing the ring gear to revolve. This results in the first



DESIGN

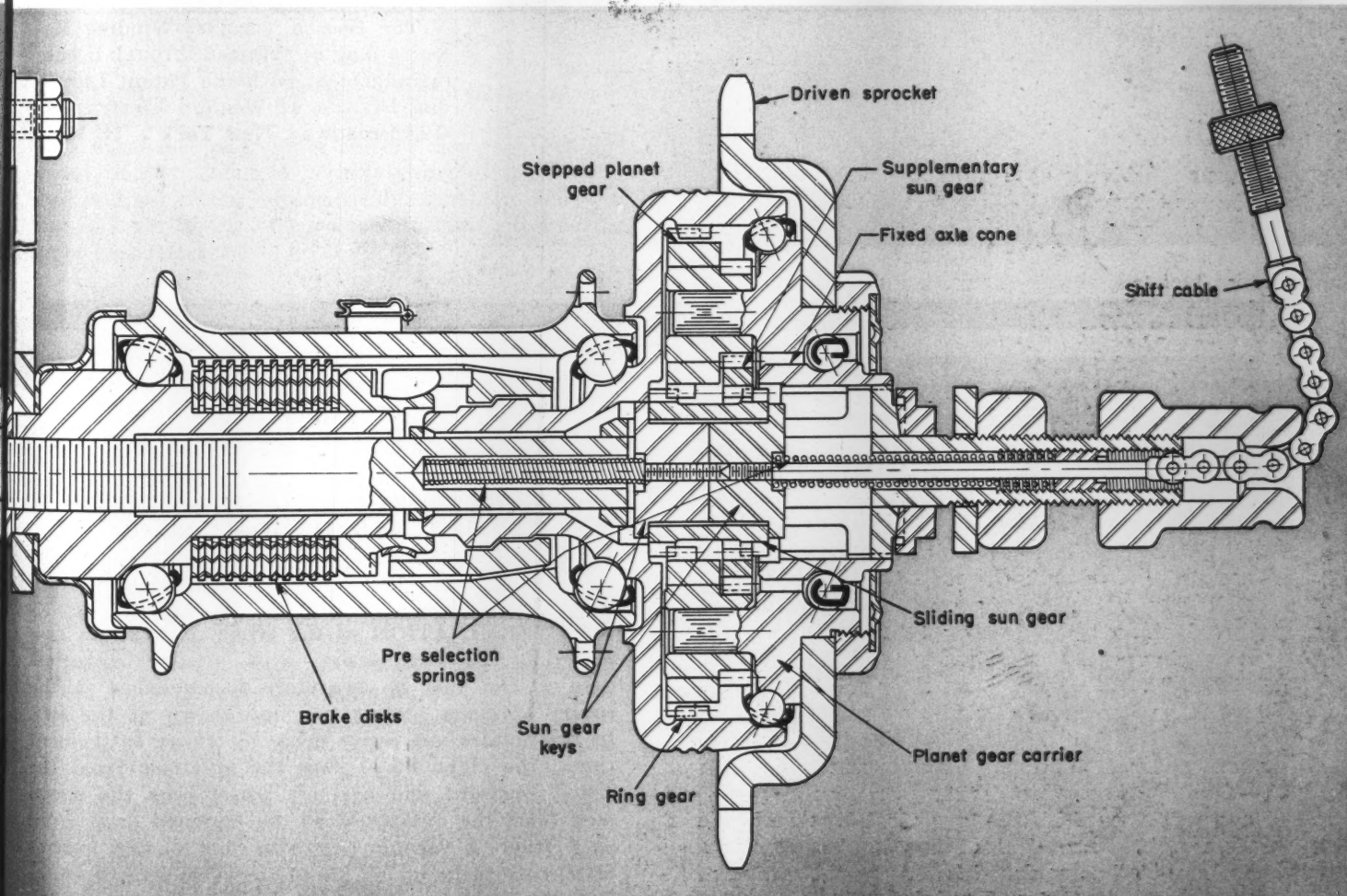
Tension Gives Three Speeds

overdrive or normal gear.

As the sliding sun gear is moved further to the right and deeper into the fixed axle cone, teeth of the sliding sun gear mesh with the internal teeth of the supplementary sun gear, allowing the small planet gear to revolve about the larger sun gear. The large planet gear, being integral with the small planet gear, drives the ring gear. This results in the second overdrive or high gear. The outward movement of the sliding sun gear is accomplished by pulling the control cable by means of the control shifting lever. When the cable tension is released, the sliding gear is allowed to move inwardly, or to the left, resulting in successive gear changes of normal and low.

Preselection of any of the three gears may be accomplished, while driving, by shifting the control lever in advance to the desired gear. When the rider wishes to shift, he momentarily relieves his pedalling pressure, at which time shifting occurs automatically.

Position of the sliding sun gear is controlled and predetermined by the movement of two spring-loaded, separable keys located on each end of the sun gear. With the sliding sun gear under torque from pedalling, the shifting lever is moved to the desired gear position to locate the sun gear key. When the torque is removed from the sun gear by momentarily stopping pedal movement, the springs move the sliding sun gear automatically to the predetermined position.

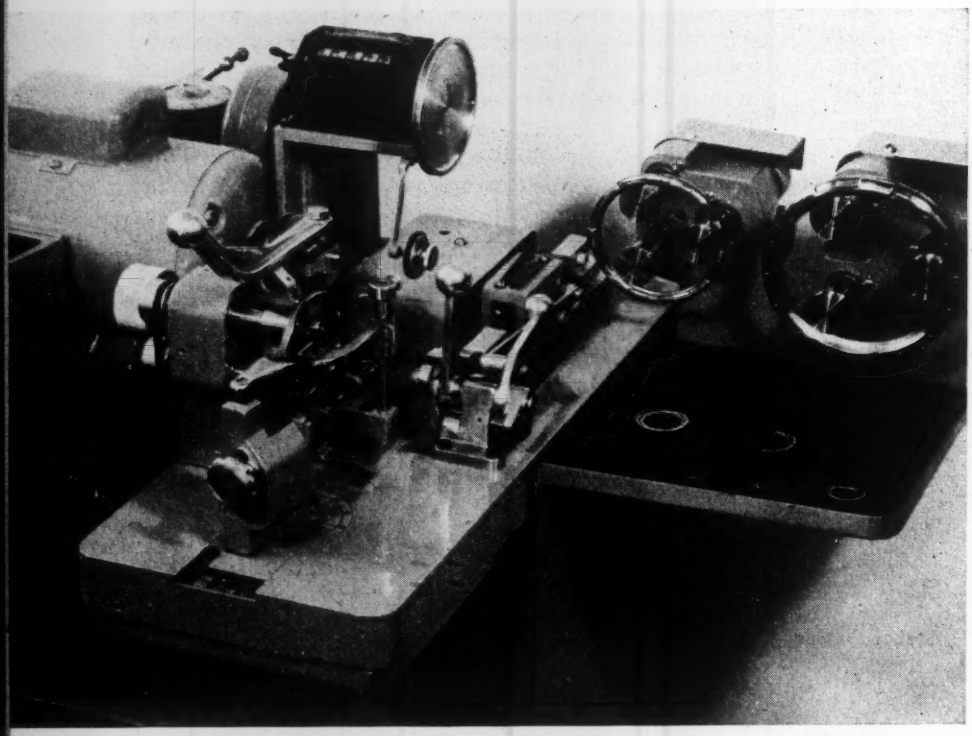


High-Speed Coil Winder

HIGH production rate on winding toroidal coils has been made possible with the Boesch winder shown below. The machine winds 42 to 20 gage enameled wire at 1100 turns per minute in producing various types of coils such as the flat stacked type consisting of layers of washer shaped laminations, the rolled type using a tight spiral core construction and the pressure molded type which can be sintered or cold-pressed. The machine is powered by an electric motor driving a Graham transmission which in turn drives a reversing clutch arrangement. Between the latter two units is placed a one-way clutch which permits reversing the motor for reeling wire on the shuttle. The work head is driven from the other end of the double extension motor shaft through a conventional pulley and belt arrangement.

A "load and fire" device operated from the reversing clutch mechanism controls oscillation of the core holder head within an adjustable range of 45 to 180 degrees. Changing the speed of the Graham drive varies the speed of oscillation of the core holder to permit close or wide spacing of wire being wound. One counting device registers footage of wire being placed on the shuttle and another counting unit totals turns placed on the core. The latter is a preset device that stops the machine when the desired number of turns have been made. Standard, interchangeable work heads permit winding coils of 3, 4 or 6-inch diameter. The combination of work heads, shuttles and sliders permits winding of coils having a minimum finished bore of 0.200-inch using 42 gage wire up to a minimum finished bore of 0.500-inch using 20 gage wire.

The Boesch Toroidal Winding Machine may be obtained through license arrangement with the Patent Licensing Division of Western Electric Co., 195 Broadway, New York 7, N. Y.



Dual-Wheel Rotary Abrasion Tester

DETERMINATION of the effect of wear on new materials in comparison with similar materials used in the past is accurately accomplished in the rotary abrasion testing machine shown at the left. In this dual-wheel tester made by Tabor Instrument Corp., the right wheel rubs the specimen from the center outward and the left wheel rubs the specimen from the outside in so the abrasion lines cross each other. A vacuum unit with dual suction nozzles efficiently picks up all abradings. Two sets of stainless steel weights, in addition to the weight of the

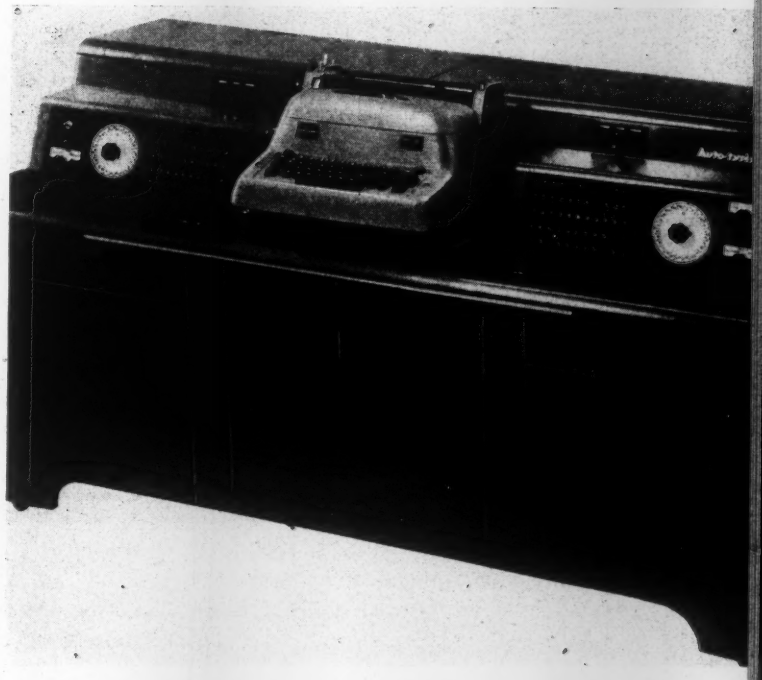
arm, provide three standard ranges of wheel pressures against the specimen, 250, 500 and 1000 grams, respectively.

A variety of holders for different kinds of specimens have been developed, such as a rimmed specimen holder that can be partially filled with a liquid to wet the specimen or completely cover it while undergoing abrasion tests. Specimens cut from a flat sheet, or coatings applied to specimen plates are tested on a flat top holder. Flexible specimens like fabrics can be drawn over the top surface of another holder and held down by a clamping ring which stretches the fabric tight. A unique multiple specimen holder is available for comparative testing of eight samples simultaneously.

Punched Rolls Actuate Letter Writer

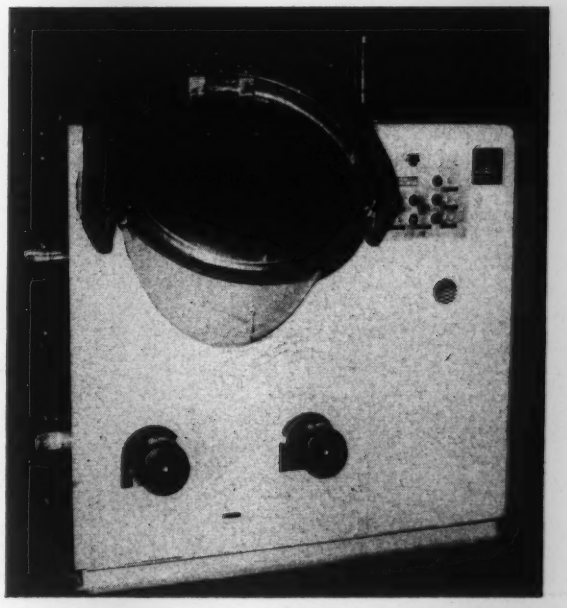
FULLY automatic letter writing machine, the model 5060 Auto-typist shown at right, operates any typewriter, electric or manual, by means of perforated paper rolls. The machine, made by The American Automatic Typewriter Co., uses a vacuum pump to provide pneumatic power to operate individual key and control bellows. A pushbutton electric switching circuit similar to that used in automatic phonographs controls the roll transmission. Two record rolls carry perforations for 100 or more different paragraphs, with pushbuttons corresponding to each of the paragraphs. By pushing buttons in the sequence desired for formation of a letter from the 100 paragraphs, the operator can preset the contents of the entire letter. The machine then automatically selects and types each paragraph through to the end of the letter.

An automatic addressing feature also has been included in this model to permit typing of the letterhead and salutation automatically. Another dial setting controls typing of envelopes to match the heading of each letter.



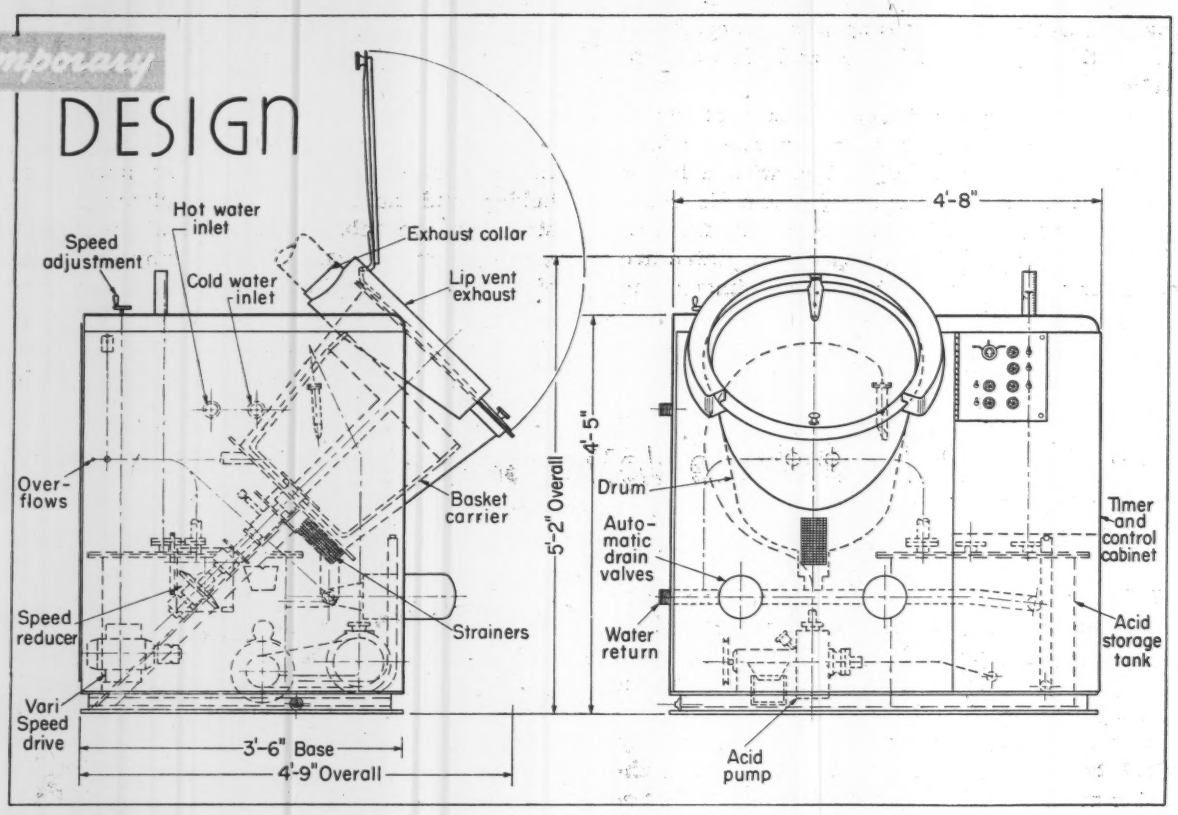
Pickler Employs Automatic Washer Principle

PICKLING of small parts, often a time-consuming hand operation in the past, can now be handled automatically in units similar to the familiar automatic clothes washer. Made by American Machine and Solvents Co., the machine shown at the right runs parts through a cyclic sequence of muratic acid baths and hot or cold water rinses. The work basket is carried in a rotating drum, drawing top of next page, with the various sprays and washes controlled by timers that can be preset to any desired cycle. Speed of tumbling is adjustable to suit the parts being handled. On completion of the cycle, a bell rings and the machine shuts down.



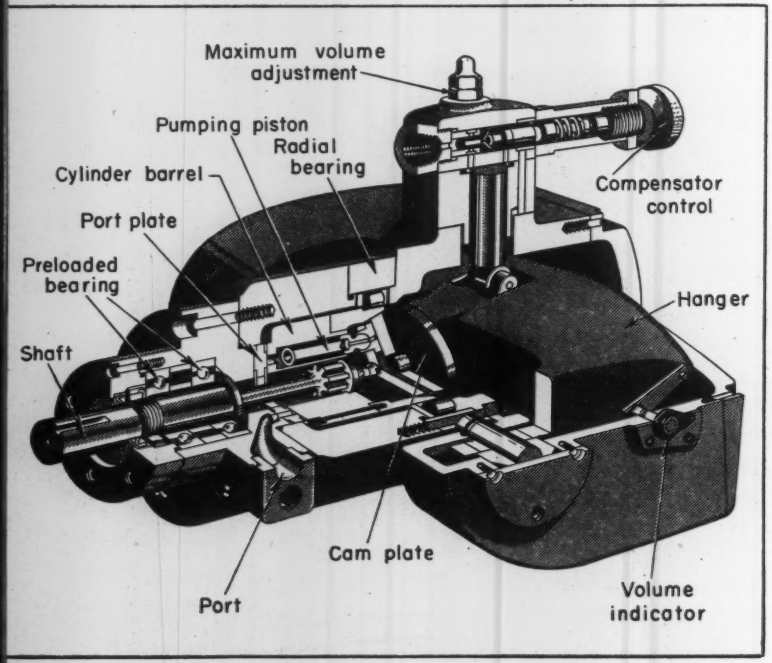
Contemporary

DESIGN



Wash water is kept from the acid and acid is prevented from going down the drain by special drain valves. Closing of these valves is not affected by chips that might get by the dual strainers. Acid fumes and vapors are removed through a lip vent exhaust hood as shown in the drawing. The machine is especially suited for processing of small parts, for batch type operations or for handling of parts in lots where work should not be mixed with other lots for inspection or control purposes.

Cam Plate Varies Pump Volume

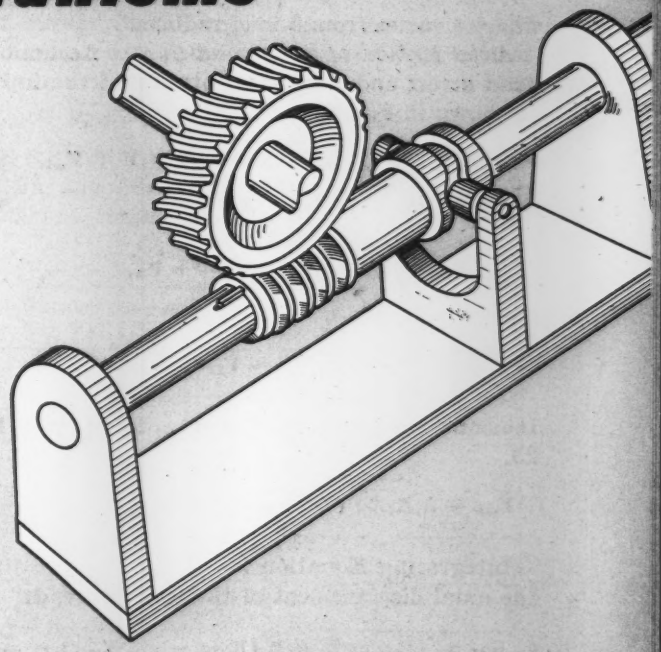


VARIABLE volume hydraulic pump made by The Denison Engineering Co. uses an adjustable, tilting cam plate to vary the stroke, and therefore the displacement, of the axial plungers. The cam plate on which the piston shoes bear is attached to a free-swinging hanger, cutaway drawing, left, that pivots to vary the amount of tilt of the cam plate. The hanger can be controlled by an automatic pressure compensator control, as shown in the drawing, or can be set manually.

The pump is designed for high-pressure, high-volume service. Despite high pressures, need for thrust bearings has been eliminated by using a hydraulically balanced plunger shoe construction. Forces created by piston thrust are balanced by bleeding hydraulic pressure to an undercut on the shoes bearing on the cam plate. Overall efficiency of the units is 90 per cent or better, with volumetric efficiencies over 95 per cent.

Intermittent Mechanisms

. . . provide rotary motion in both directions, with or without intermediate dwell, and continuous advance in one direction



By Guy J. Talbourdet
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Beverly, Mass.

Part 2—Screw and Gear

LAST month's article presented the analysis of a cam-controlled planetary mechanism for obtaining intermittent output motion that includes both forward and reverse rotation with or without dwell. Another method of obtaining this type of motion is illustrated in *Figs.* 8 and 9.

The mechanism consists of a screw or worm, *B*, and a cam, *C*, which together are free to slide on the input shaft, *A*. The sliding motion of screw *B* and cam *C* is controlled by the action of cam *C* against a roll, *D*, which is fixed in the frame of the machine. Screw *B* is integral with cam *C* and engages with output gear, *S*. As with the mechanism discussed in the preceding article, the motion of the output gear can be made to meet three distinct conditions of motion —clockwise rotation, counterclockwise rotation, and dwell.

CLOCKWISE ROTATION OF OUTPUT GEAR: Zero acceleration and deceleration at the beginning and end of the clockwise rotation are obtained if the output shaft motion is as defined in the following equations (see Nomenclature):

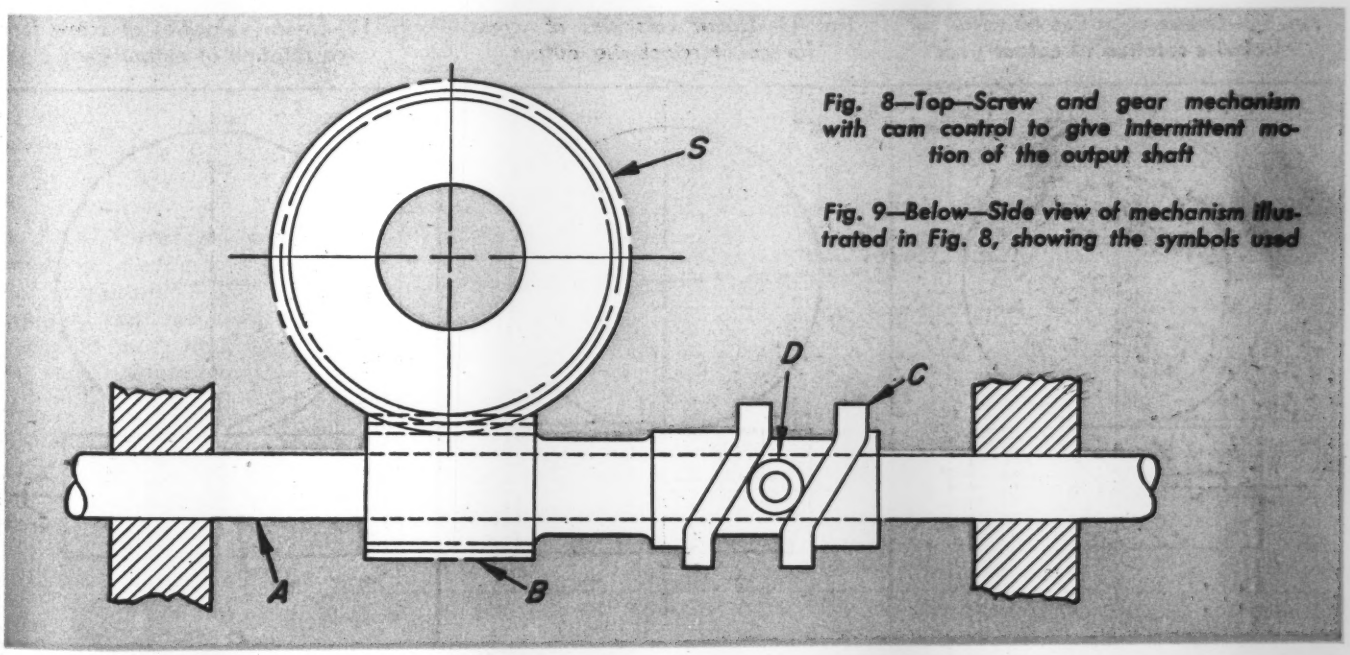


Fig. 8—Top—Screw and gear mechanism with cam control to give intermittent motion of the output shaft

Fig. 9—Below—Side view of mechanism illustrated in Fig. 8, showing the symbols used

$$\theta_{s1} = k_1 (K_1\theta - \sin K_1\theta) \quad (22)$$

$$\omega_{s1} = k_1 K_1 \omega (1 - \cos K_1\theta) \quad (23)$$

$$\alpha_{s1} = k_1 K_1^2 \omega^2 \sin K_1\theta \quad (24)$$

where θ varies from 0 to θ_1 radians.

Axial Motion of Screw and Cam: Assuming a left-hand screw and clockwise rotation of the input shaft, as shown in *Fig.* 10,

$$V_{s1} = V - (-V_{A1}) = V + V_{A1}$$

But $V = L\omega/2\pi$, therefore

$$V_{s1} = \frac{L\omega}{2\pi} + V_{A1}$$

from which

$$V_{A1} = V_{s1} - \frac{L\omega}{2\pi}$$

Inasmuch as $V_{s1} = \omega_{s1} R$, and ω_{s1} is given by Equation 23,

$$V_{A1} = k_1 K_1 R\omega (1 - \cos K_1\theta) - \frac{L\omega}{2\pi} \quad (25)$$

Integrating Equation 25 with respect to time gives the axial displacement of the screw thread:

$$S_{A1} = \int V_{A1}\, dt = k_1 R (K_1\omega t - \sin K_1\omega t) - \frac{L\omega t}{2\pi} + c$$

When $t = 0$, $S_{A1} = 0$; therefore the constant of integration, c, is zero and

$$S_{A1} = k_1 R (K_1\theta - \sin K_1\theta) - \frac{L\theta}{2\pi} \quad (26)$$

Differentiating Equation 25 with respect to time gives the axial acceleration of the screw thread:

$$a_{A1} = k_1 K_1^2 R\omega^2 \sin K_1\theta \quad (27)$$

where θ varies from 0 to θ_1. When $\theta = \theta_1$,

$$S_{A1} = k_1 K_1 R\, \theta_1 - \frac{L\theta_1}{2\pi} \quad (28)$$

The sin $K_1\theta$ term drops out because $K_1\theta_1 = 2\pi$.

COUNTERCLOCKWISE ROTATION OF OUTPUT GEAR: Equations of motion are similar to Equations 22, 23 and 24 with the signs reversed:

$$\theta_{s2} = -k_2 (K_2\theta - \sin K_2\theta) \quad (29)$$

$$\omega_{s2} = -k_2 K_2 \omega (1 - \cos K_2\theta) \quad (30)$$

$$\alpha_{s2} = -k_2 K_2^2 \omega^2 \sin K_2\theta \quad (31)$$

where θ varies from 0 to θ_2.

Axial Motion of Screw: From *Fig.* 11,

$$-V_{s2} = -V_{A2} - (+V)$$

or

$$V_{s2} = V + V_{A2}$$

from which

$$V_{A2} = V_{s2} - V$$

Following the same procedure as was employed in developing Equations 25, 26 and 27, the equations of axial motion of the screw can be derived, with these results:

$$V_{A2} = -k_2 K_2 R\omega (1 - \cos K_2\theta) - \frac{L\omega}{2\pi} \quad (32)$$

$$S_{A2} = -k_2 R (K_2\theta - \sin K_2\theta) - \frac{L\theta}{2\pi} \quad (33)$$

$$a_{A2} = -k_2 K_2^2 R\omega^2 \cos K_2\theta \quad (34)$$

where θ varies from 0 to θ_2. When $\theta = \theta_2$,

$$S_{A2} = -k_2 K_2 R\, \theta_2 - \frac{L\theta_2}{2\pi} \quad (35)$$

OUTPUT GEAR STATIONARY: Here $\theta_{s3} = 0$, $\omega_{s3} = 0$, and $\alpha_{s3} = 0$.

Axial Motion of Screw: From *Fig.* 12,

$$0 = V - (-V_{A3}) \text{ or } V_{A3} = -V$$

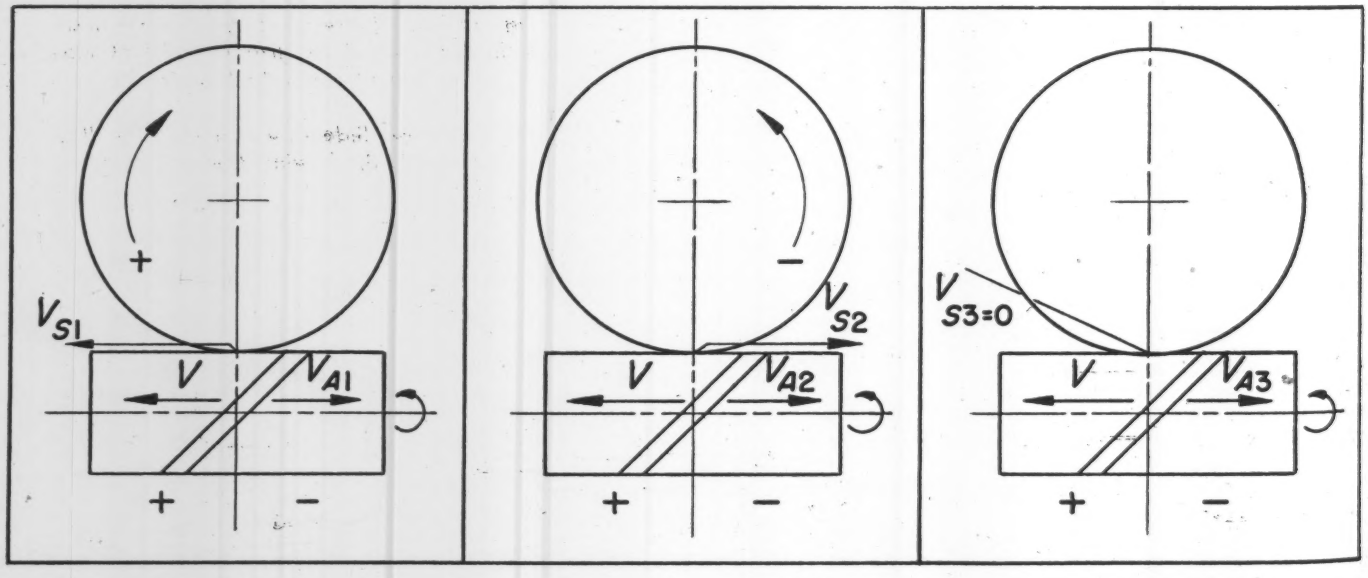
But $V = L\omega/2\pi$, therefore

$$V_{A3} = -\frac{L\omega}{2\pi} \quad (36)$$

Fig. 10—Linear velocities of screw for clockwise rotation of output gear

Fig. 11—Linear velocities of screw for counterclockwise output

Fig. 12—Linear velocities of screw for zero rotation of output gear



Integrating Equation 36

$$S_{A3} = \int V_{A3}\, dt = -\frac{L\omega t}{2\pi} + c$$

when $t = 0$, $S_{A3} = 0$, therefore $c = 0$ and

$$S_{A3} = -\frac{L\theta}{2\pi} \quad \ldots\ldots (37)$$

where θ varies from 0 to θ_3. When $\theta = \theta_3$,

$$S_{A3} = -\frac{L\theta_3}{2\pi} \quad \ldots\ldots (38)$$

GEAR RATIO: It is necessary to establish the relation between gear ratio, m, and the maximum angular displacements of output gear during a complete cycle of driving screw and cam. To obtain the desired conditions of motion of the output gear, the position of screw and cam must be the same at the start and at the end of the cam cycle:

$$S_{A1} + S_{A2} + S_{A3} = 0 \quad \ldots\ldots (39)$$

where S_{A1}, S_{A2} and S_{A3} have the values given in Equations 28, 35 and 38. Substituting these values in Equation 39 and simplifying,

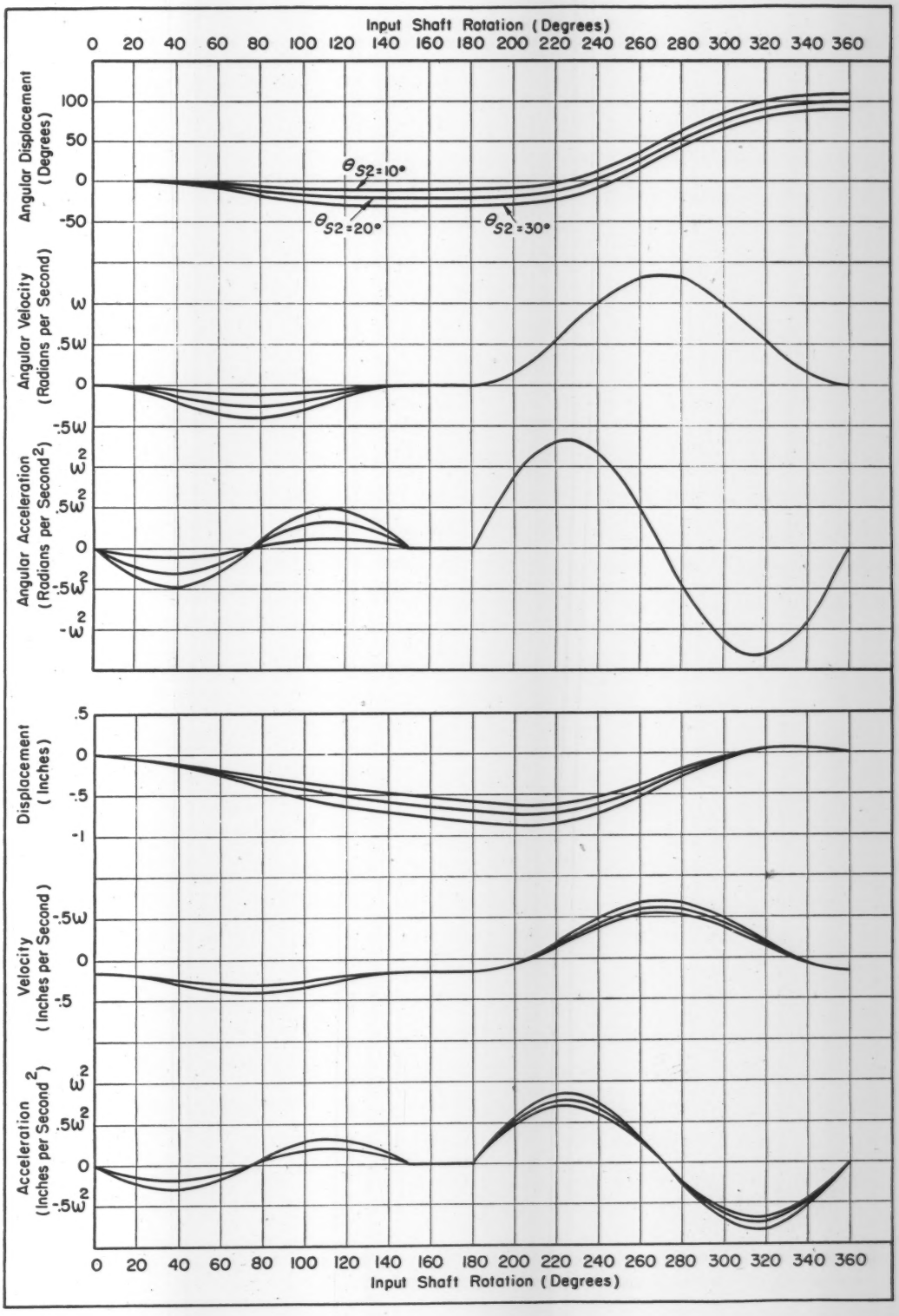


Fig. 13 — Angular displacement, velocity, and acceleration of output shaft as a function of input shaft rotation

Fig. 14 — Linear displacement, velocity, and acceleration of screw and cam corresponding to the output shaft motion illustrated in Fig. 13

$$\frac{L}{2\pi} = \frac{R\,(k_1K_1\theta_1 - k_2K_2\theta_2)}{\theta_1 + \theta_2 + \theta_3}$$

But $\theta_1 + \theta_2 + \theta_3 = 2\pi$, $k_1K_1 = \theta_{s1max}/\theta_1$, and $k_2K_2 = \theta_{s2max}/\theta_2$ (see Nomenclature). Then

$$\frac{L}{2\pi} = \frac{R\,(\theta_{s1\ max} - \theta_{s2\ max})}{2\pi}$$

or

$$\frac{L}{R} = (\theta_{s1\ max} - \theta_{s2\ max})$$

Also $\theta_{s1max} = 2\pi k_1$ and $\theta_{s2} = 2\pi k_2$, therefore

$$\frac{L}{R} = 2\pi\,(k_1 - k_2)$$

But $L/2\pi R = m$, the ratio between number of starts in screw and number of teeth in gear, therefore

$$m = k_1 - k_2 = \frac{\theta_{s1\ max} - \theta_{s2\ max}}{2\pi} \quad \ldots\ldots\ldots\ldots (40)$$

The motions of the output shaft and of the screw and cam are illustrated in *Figs.* 13 and 14. The angular displacement, velocity and acceleration of the output shaft and the linear displacement, velocity and acceleration of the screw and cam have been plotted as a function of the angular displacement of the screw and cam rotating uniformly at the rate of 1 radian per second. *Fig.* 13 indicates the motion of an output shaft which rotates counterclockwise during 150 degrees rotation of the input shaft, then remains stationary during 30 degrees rotation of the input shaft, and finally rotates 120 degrees clockwise during the remaining 180 degrees rotation of the input shaft. The three sets of curves are for output shaft counterclockwise rotation of 10, 20 and 30 degrees, respectively. *Fig.* 14 indicates the axial motion of the screw and cam to obtain the desired motions of the output shaft under the foregoing conditions. A left-hand screw and clockwise rotation of the input screw and camshaft are assumed.

Nomenclature

θ = Angular displacement of uniformly rotating member

ω = Angular velocity of uniformly rotating member, radians per second

L = Lead of screw, inches

R = Pitch radius of output gear, inches

m = Ratio between number of starts in screw and number of teeth in gear

V = Uniform axial velocity of screw thread, inches per second

S_{A1}, V_{A1}, a_{A1} = Axial motion of screw thread during clockwise rotation of output gear

S_{A2}, V_{A2}, a_{A2} = Axial motion of screw thread during counterclockwise rotation of output gear

S_{A3}, V_{A3}, a_{A3} = Axial motion of screw thread during dwell period of output gear

θ_{s1}, ω_{s1}, α_{s1} = Clockwise angular motion of output shaft

θ_{s2}, ω_{s2}, α_{s2} = Counterclockwise angular motion of output shaft

θ_1 = Total angular displacement of uniformly rotating cam during clockwise motion of output shaft

θ_2 = Total angular displacement of uniformly rotating cam during counterclockwise motion of output shaft

θ_3 = Total angular displacement of uniformly rotating cam during rest period of output shaft

K_1 = Ratio between a complete cam cycle and the angular displacement of the cam required to rotate output shaft clockwise a desired amount = $2\pi/\theta_1$

K_2 = Ratio between a complete cam cycle and the angular displacement of the cam required to rotate output shaft counterclockwise a desired amount = $2\pi/\theta_2$

k_1 = Ratio between angular displacement of output shaft rotating clockwise and a complete cam cycle = $\theta_{s1\ max}/2\pi$

k_2 = Ratio between angular displacement of output shaft rotating counterclockwise and a complete cam cycle = $\theta_{s2\ max}/2\pi$

$k_1K_1 = \theta_{s1\ max}/\theta_1$

$k_2K_2 = \theta_{s2\ max}/\theta_2$

How To Use Equations

EXAMPLE: To illustrate the application of the equations, the calculations will be worked out for the conditions shown in *Fig.* 13 and described in the preceding paragraph, for maximum counterclockwise rotation of the output shaft, θ_{s2}, equal to 30 degrees. Here the output shaft will constantly advance 90 degrees clockwise per revolution of the input shaft. The conditions are

$\theta_1 = 180$ degrees $\qquad$ $\theta_2 = 150$ degrees

$\theta_{s1\ max} = 120$ degrees $\qquad$ $\theta_{s2\ max} = 30$ degrees

$\theta_3 = 30$ degrees

From the Nomenclature,

$$K_1 = 2\pi/\theta_1 = 360/180 = 2$$

$$k_1 = \theta_{s1max}/2\pi = 120/360 = 1/3$$

$$K_2 = 2\pi/\theta_2 = 360/150 = 2.4$$

$$k_2 = \theta_{s2\ max}/2\pi = 30/360 = 1/12$$

From Equation 40, $m = k_1 - k_2 = (1/3) - (1/12) = 1/4$. Letting $L = 1$ inch, $R = L/2\pi m = 1/(2\pi \times 1/4) = 0.63661$-inch.

For the motion of the output shaft starting with the counterclockwise rotation, then the dwell period, and finally the clockwise rotation, the equations become, respectively:

For input shaft motion from 0 to 150 degrees, the output shaft motion is given by

$\theta_{s2} = -(1/12)\,(2.4\theta - 57.29564 \sin 2.4\theta)$ ..... (From Equation 29)

$\omega_{s2} = -0.2\omega\,(1 - \cos 2.4\theta)$ ..... (From Equation 30)

$\alpha_{s2} = -0.48\omega^2 \sin 2.4\theta$ ..... (From Equation 31)

where θ varies from 0 to 150 degrees.

For input shaft motion from 150 to 180 degrees the output shaft is stationary. For input shaft motion

from 180 to 360 degrees the output shaft motion is given by

$$\theta_{s1} = -30° + 1/3\ (2\theta - 57.29564 \sin 2\theta) \quad \text{(From Equation 22)}$$

$$\omega_{s1} = (2/3)\omega\ (1 - \cos 2\theta) \quad \text{(From Equation 23)}$$

$$\alpha_{s1} = (4/3)\ \dot{\omega}^2 \sin 2\theta \quad \text{(From Equation 24)}$$

where θ varies from 0 to 180 degrees. Here θ is the actual input shaft rotation, *Fig.* 13, minus 180 degrees.

These values have been calculated and plotted in *Fig.* 13 with the input shaft motion as abscissa.

For the axial motion of the screw and cam required to obtain the desired motion of the output shaft the equations are, respectively:

For input shaft motion from 0 to 150 degrees

$$S_{A2} = -\ 0.05304 \left(\frac{2.4\theta}{57.29564} - \sin 2.4\theta\right) - \frac{1 \times \theta}{360} \quad \text{(From Equation 33)}$$

$$V_{A2} = -\ 0.12732\ \omega\ (1 - \cos 2.4\theta) - \frac{1 \times \omega}{2\pi} \quad \text{(From Equation 32)}$$

$$a_{A2} = -\ 0.30557\omega^2 \sin 2.4\theta \quad \text{(From Equation 34)}$$

where θ varies from 0 to 150 degrees.

For input shaft motion from 150 to 180 degrees, output shaft is stationary, therefore

$$S_{A3} = S_{A2\,max} - \frac{1 \times \theta}{360} \quad \text{(From Equation 37)}$$

$$V_{A3} = -\frac{1 \times \omega}{2\pi} \quad \text{(From Equation 36)}$$

where θ varies from 0 to 30 degrees. Here θ is the actual input shaft rotation, *Fig.* 14, minus 150 degrees.

For input shaft motion from 180 to 360 degrees,

$$S_{A1} = S_{A2\,max} + S_{A3\,max} + 0.21220 \left(\frac{2\theta}{57.29564} - \sin 2\theta\right) - \frac{1 \times \theta}{360} \quad \text{(From Equation 26)}$$

$$V_{A1} = 0.42440\ (1 - \cos 2\theta) - \frac{1 \times \omega}{2\pi} \quad \text{(From Equation 25)}$$

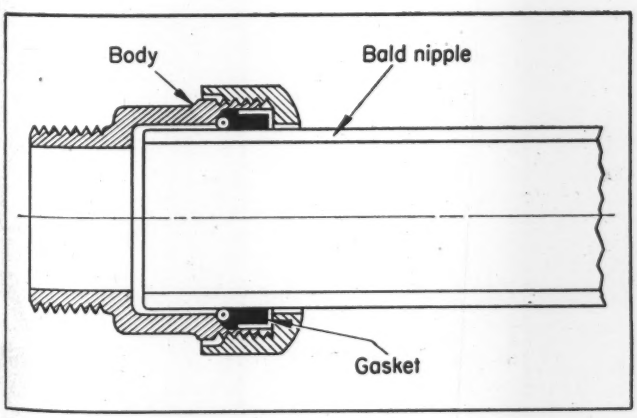
$$a_{A1} = 0.84880\omega^2 \sin 2\theta \quad \text{(From Eqaution 27)}$$

where θ varies from 0 to 180 degrees. Here θ is the actual input shaft rotation minus 180 degrees.

These values have been calculated and are plotted on *Fig.* 14 with the motion of the input shaft as abscissa. Values for the manufacture of the cam leader are obtained from the linear displacement of the screw and cam. The same analysis applies when the screw and gear are replaced by two helical gears on parallel shafts with one of them moving axially.

Compression Fitting Speeds Assembly

MAKING up of pipe joints in closely confined areas and where ends of the two pipes may be slightly misaligned was simplified in the condensation pumps made by Whittington Pump and Engineering Corp. by the use of "No-Thread" compression couplings. The pump shown at the right uses a street ell and a male adapter, shown in the drawing below, coupled to a bald nipple welded to the tank. A product of Dresser Manufacturing Div., Dresser Industries Inc., the coupling consists of a sleeve or body threaded to receive a compression end nut. When this end nut is tightened, uniform high pressure is exerted on the pipe walls through a tapered gasket recess and rubber gasket, making a flexible but tight seal. Gaskets are protected from damage by steel retainer clips. With this arrangement, misalignment up to about 6 degrees can be accommodated. Also, assembly time is reduced since nipples need not be cut to exact length. The coupling allows for variations up to about ½-inch in length.



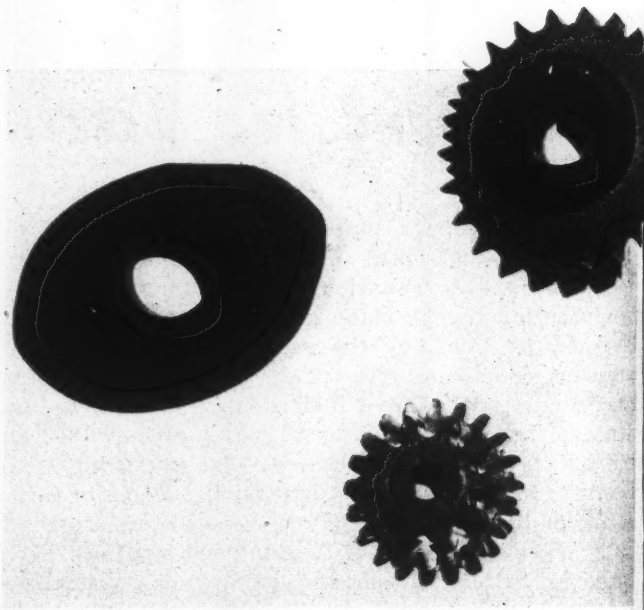
Materials Selection . . .

One Key to Production Economy

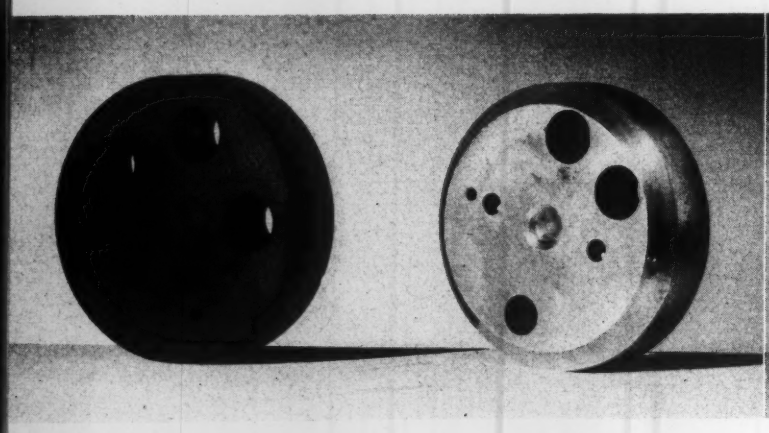
SELECTION of materials constitutes one of the key segments in the overall job of good design for economical manufacturing. It is on a par with consideration of features to suit the particular process to be employed and use of tolerances commercially practicable. And, in many cases, the material selected or dictated by design conditions has a direct influence on the production method or methods which can be economically utilized.

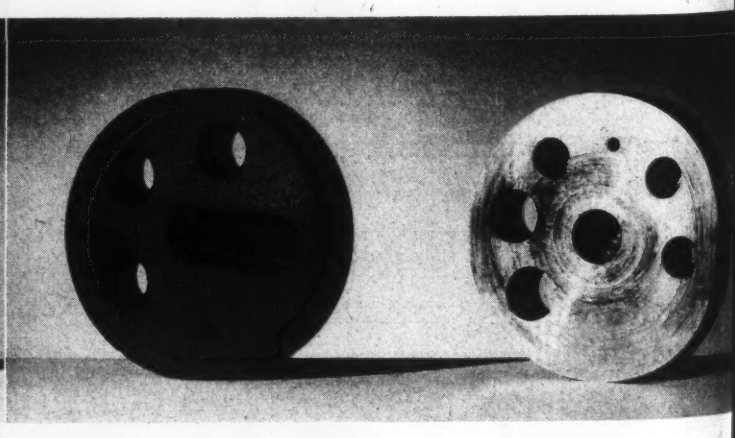
In the accompanying group of case histories, the materials utilized influenced greatly the final result. Design advantages and cost savings indicated may give a clue to further achievements of a similar nature on multitudes of other parts in use or in the process of design.

SPROCKET for a chain drive, complex multiple gear for an industrial counter, and a cam for a coin-operated record player, right, produced by powder metallurgy. Savings over the original designs ranged from 35 to 96 per cent and hobbing, broaching, shaping, and drilling operations were eliminated in the production of these parts from U. S. Graphite Co. Gramix powders.

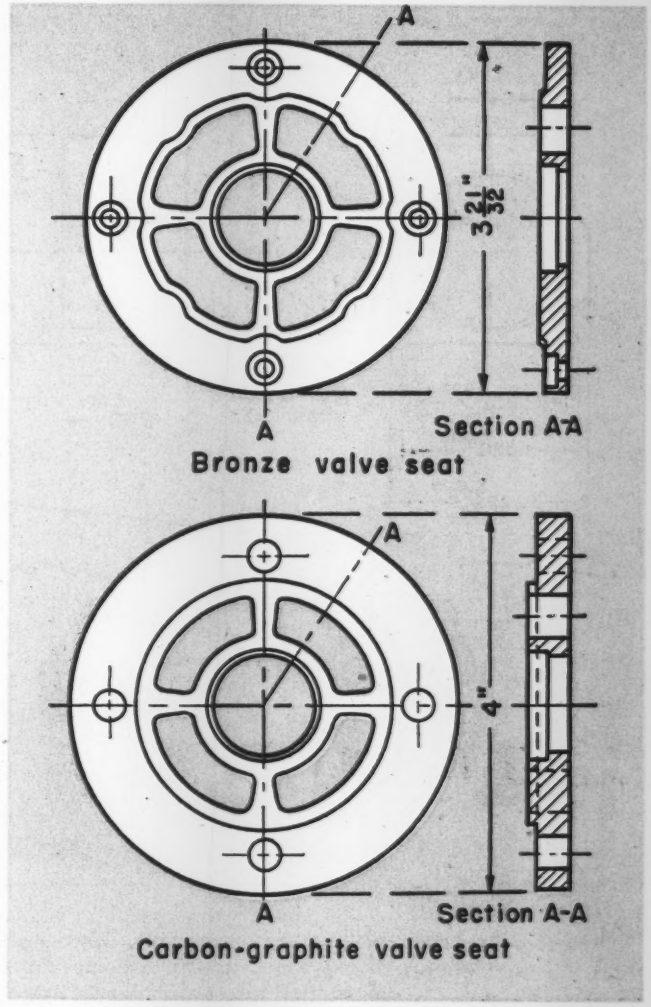


ROTOR plate for an American Sterilizer Co. steam valve, below, redesigned for use of carbon-graphite material reduced the cost of the original stainless type 303 rotor by 57 per cent. Made from U. S. Graphite Co. Graphitar grade 14, the rotor plate

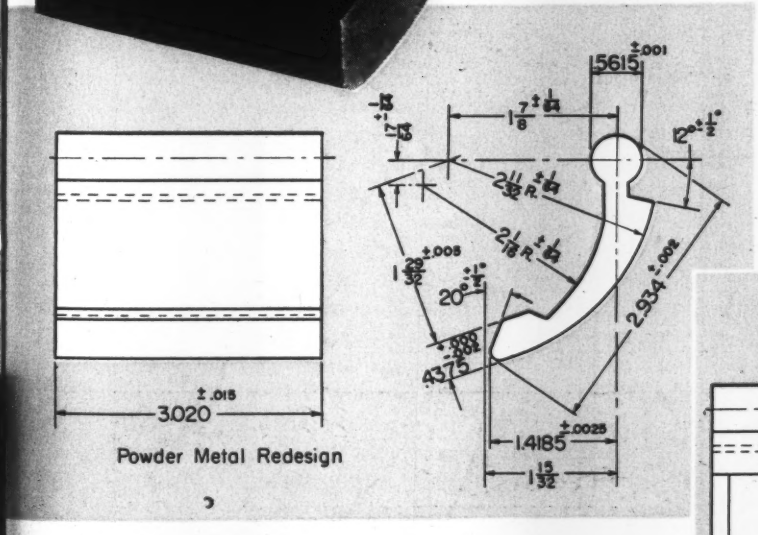




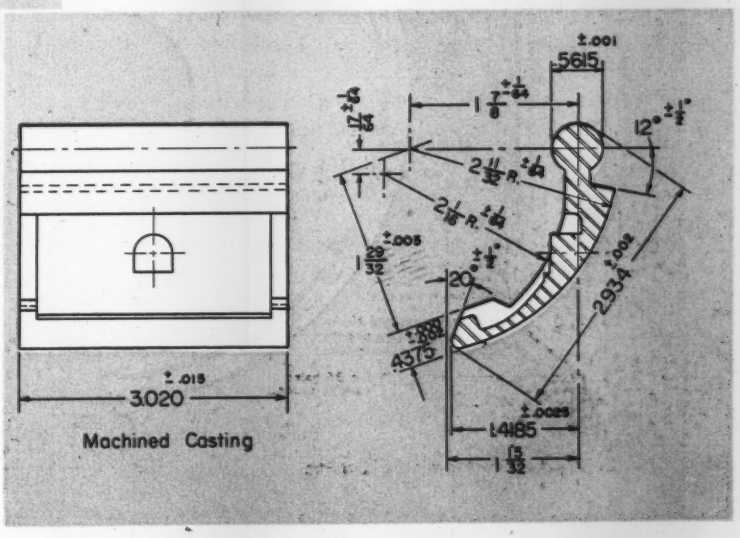
provides at least four times the service life realized with stainless steel. Redesign involved molding the rotor cross slot rather than drilling and plugging to connect ports.



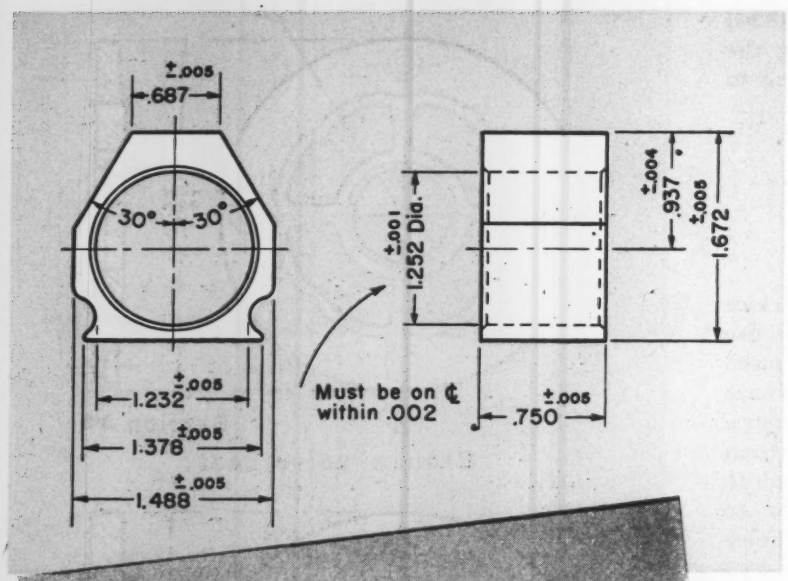
VALVE seat for the Gilbert & Barker Co. service station gasoline pump, right, redesigned for use of carbon-graphite material resulted in a per-piece price almost identical to that of the original bronze part. Change in material, however, reduced service complaints in the field from 10 per cent to less than one-half of one per cent. Redesign for U. S. Graphite Co. Graphitar involved increasing the diameter to permit greater wall thickness around the bolt holes and allowing added thickness for strength.

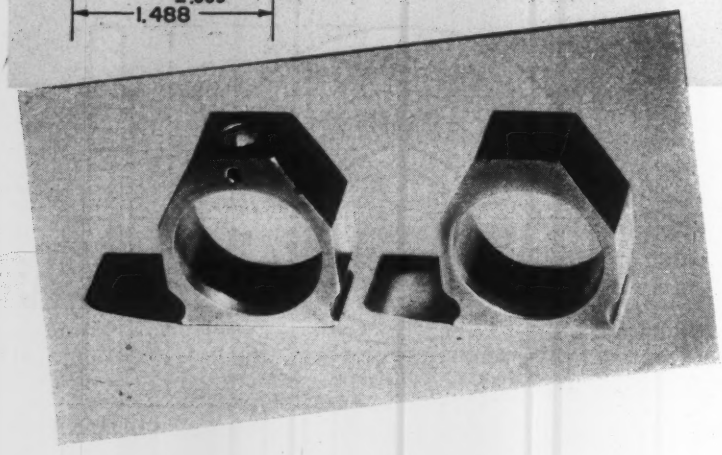


plete the metal-powder part. Character of the sintered Amplex Super Oilite material provides self-oiling properties and eliminated supplementary external lubrication for the knuckle.



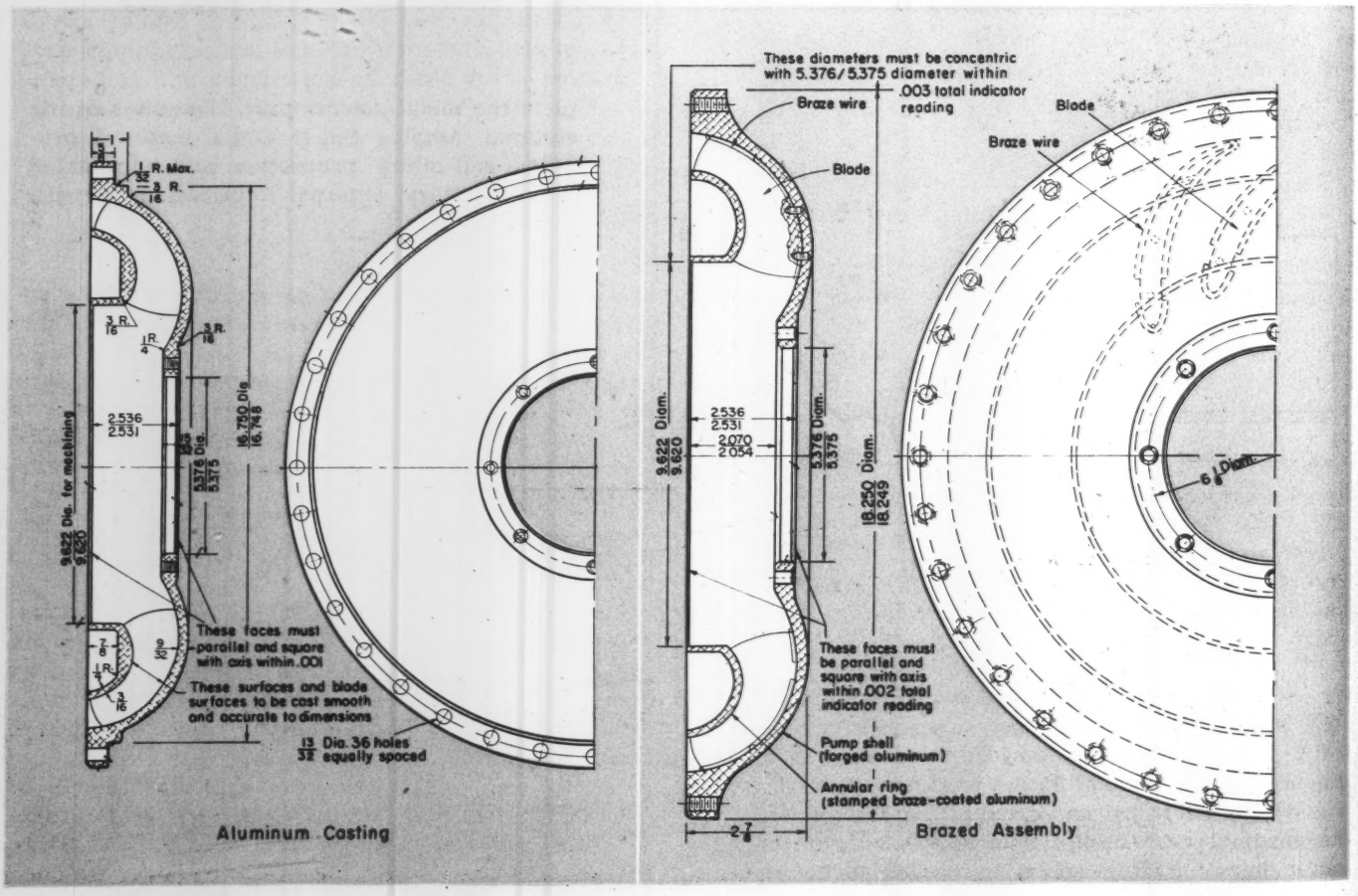
WING vane for a rotary pump redesigned for production by powder metallurgy resulted in a reduction of 25 per cent in cost. Milling, drilling, turning, and grinding required with the original cast design was supplanted by a single minor milling operation needed to com-





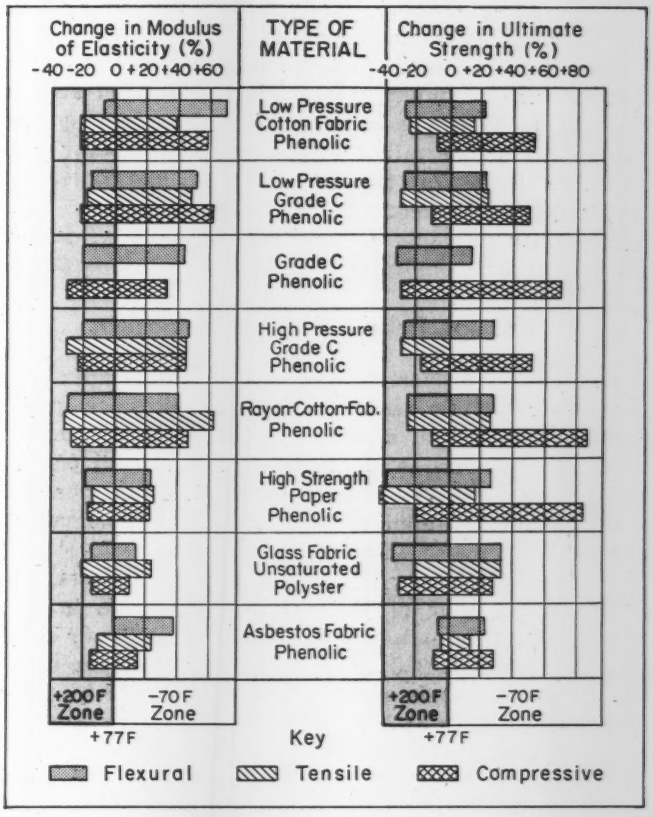
BEARING block of Amplex Oilite bronze, left, replacing one made from extruded solid bronze bar cost one-third as much in finished form although two holes are drilled before assembly. Amount of material machined away was reduced from 57 per cent to a few per cent.

PUMP impeller for the White Motor Co. bus torque converter, below, redesigned from cast aluminum to brazed wrought and forged construction resulted in a cost reduction of two-thirds. Hazards in the strength of cast aluminum members operating in public carriers as well as cracks, porosity, core shift, and other casting defects which increased costs, made necessary the redesign to stronger material and less costly production. Developed in conjunction with Aluminum Co. of America, the brazed design uses a drawn wrought aluminum annular ring, a forged aluminum shell and cast blades. The brazed design, in addition to reducing the cost from $150 to $50 per unit ready for machining, also reduced the problems attendant to dynamic balancing the impellers in production.



Laminated Plastics

. . . how temperature affects their mechanical properties



Bar charts comparing changes in mechanical properties with temperature for eight plastic laminates. For both charts, the blocks to the left of the zero line indicate the relative changes in flexural, tensile, and compressive properties when the temperature is raised from 77 to 200 F; those to the right of the line show the corresponding changes when the temperature is lowered from 77 to −70 F. Changes are shown in percentage

HIGH impact strength at low temperatures and low thermal conductivity of laminated plastics have been responsible for the widespread application of these materials to refrigerators and freezers. Light weight and high strength have also brought about increasing application in aircraft, especially for accessories and semistructural parts such as radomes, floors, bulkheads, propellers, wing flaps, and ducts. Although these laminates are subjected to a wide range of temperature, little or no information has been available on their mechanical properties at temperature extremes.

To provide such information, the mechanical properties of eight representative laminated plastics were evaluated at both high and low temperatures and reported by J. J. Lamb, Isabelle Albrecht, and B. M. Axilrod in "Mechanical Properties of Laminated Plastics at −70, 77, and 200 F," *Journal of Research* published by the National Bureau of Standards. Izod impact strengths; flexural, tensile, and compressive strengths; and elastic moduli were measured. One of the laminates was a polyester resin with glass-fabric reinforcement while the others were phenolic resins reinforced with asbestos fabric, paper, cotton fabric, and rayon fabric.

Tests were carried out in thermally insulated enclosures built especially for this purpose. Special jigs and fixtures were also required for the flexural and compression tests. For the impact tests, a Baldwin-Southwark pendulum-type Izod impact machine was used. The flexural, tensile, and compressive tests employed two Baldwin-Southwark hydraulic universal testing machines located in a room in which the atmosphere was controlled at 77 F and 50 per cent relative humidity. In the bar chart, above, are shown the percentage changes in strength and modulus of elasticity with temperature based on 77 F values for flexural, tensile, and compressive tests. Properties at 77 F for these materials are listed in the accompanying tabulation.

Tensile strengths of the high-strength paper, rayon-fabric, and glass-fabric laminates are about three times those of the cotton-fabric and asbestos-fabric phenolics. In compressive strength the glass-fabric laminate is outstanding. At 77 F its strengths in the crosswise and lengthwise directions are 36,000 and 42,000 psi, respectively. The compressive strengths of the other laminates are about 21,000 psi.

Strengths Increase at Low Temperatures

For the cellulose laminates, the increase in compressive strength at the low temperature is much greater in magnitude than the decrease at the high temperature. The tensile strength variation, however, is less at the low temperature than at the high temperature.

Tensile and compressive strengths and moduli of elasticity of all the laminates increase at low temperature and decrease at high temperature. Thus, for all laminates except the asbestos-fabric product,

the tensile and compressive strengths at 200 F are approximately half the corresponding values at −70 F. For the asbestos-fabric product, however, changes in strength values are much smaller.

Changes in tensile and compressive moduli with temperature are much greater from −70 to 77 F than from 77 to 200 F. Except for the high-strength-paper material, the overall changes are greater for the cellulose than for the mineral-type laminates. In general, high-strength-paper, asbestos-fabric and glass-fabric products show about the same variation of tensile and compressive moduli with temperature.

Asbestos Fabric Retains Properties

In flexural properties the high-strength-paper and glass-fabric laminates are superior. All the samples increase in flexural strength at low temperature. At high temperature, a decrease occurs for all except the asbestos-fabric laminate which does not change. For cellulose laminates, the tensile and flexural strengths increase 15 to 25 per cent at −70 F and decrease 25 to 40 per cent at 200 F. The compressive-strength behavior of the cellulose materials is different; the increases at −70 F are 50 to 85 per cent, the decreases at 200 F are only 10 to 30 per cent. For a given sample, the percentage increase in compressive strength at −70 F is at least double the percentage increase in flexural or tensile strength. At 200 F the percentage loss in compressive strength, in general, is half the percentage loss in flexural or tensile strength.

When the samples are compared on the basis of specific strength values, the paper and rayon-fabric laminates are superior to the other. The low-pressure Grade C phenolic laminate compares favorably in flexural strength properties with the high-pressure laminate made with the same reinforcement, especially when the comparison is made in terms of specific strength properties.

Increases in the three moduli of elasticity of the five cellulose-fabric laminates at −70 F are about 40 to 60 per cent, and the decreases in moduli of elasticity at 200 F are from 15 to 30 per cent. The high-strength-paper laminate, for which the three moduli change very similarly, shows smaller changes in moduli at −70 F than the other cellulose laminates.

Percentage changes in strength with temperature of the laminates with mineral reinforcement do not vary much with the type of test, in contrast to the cellulose laminates, for which the variation in compressive strength with temperature is much different from the percentage changes in flexural and tensile strength. The percentage changes in flexural, tensile, and compressive strengths of the asbestos-facric laminate increase 15 to 30 per cent at −70 F and de- about 5 per cent at 200 F.

The percentage changes in the three strength values for the glass-fabric laminate are nearly alike, particularly at −70 F. The respective increases in the flexural, tensile, and compressive moduli of the glass fabric laminates at −70 F are almost equal to the decreases at 200 F. The changes in flexural and compressive moduli are about 12 per cent; the tensile modulus changes are 22 per cent. The overall changes in the moduli of elasticity of the asbestos-fabric laminate for the temperature range are approximately 30 per cent; there is no regularity in these changes.

Impact Strength Depends on Laminate

The Izod impact strength vs. temperature trend of the laminated plastics is different for the various types of reinforcement. The glass-fabric laminates decrease steadily in impact strength with increasing temperature, the value of 200 F being about 70 per cent of the −70 F value. The asbestos-fabric, rayon-fabric, and high-strength-paper laminates show little variation in impact strength between −70 and 200 F. The cotton-fabric laminates exhibit increasing impact strength with temperature, roughly doubling their impact strength between −70 and 200 F. The Izod impact-strength values for the rayon-fabric and the glass-fabric laminates are much greater than for the other materials.

Results of the study indicate that the flexural properties of plastic laminates at high temperature are not a function of temperature only, but may be affected by further cure of the resin and loss of moisture content. The effect of high humidity in addition to an elevated temperature may be quite different from the effect of temperature alone. Thus, a severe loss in strength was noted for the high-strength-paper and one low-pressure cotton-fabric laminate at 150 F when the humidity was increased to 90 per cent.

Properties of Plastic Laminates at 77 F and 50 Per Cent Relative Humidity*

Type of Laminate	Ply Arrangement	Density (g/cm³)	Impact Strength (ft-lb/inch of notch) Flatwise	Impact Strength (ft-lb/inch of notch) Edgewise	Tensile Modulus of Elasticity (10^6 psi)	Tensile Strength (10^3 psi)	Flexural Strength (10^3 psi)	Compressive Strength (10^3 psi)
Low-Pressure Cotton-Fabric Phenolic	Cross	1.34	6.0	3.2	1.0	12	18	22
Low-Pressure Grade C Phenolic	Cross	1.28	6.6	3.3	0.8	9	16	19
High-Pressure Grade C Phenolic	Cross	1.36	5.7	2.8	1.0	10	18	20
Grade C Phenolic	Parallel	1.34	5.1	2.7	..	..	21	25
Rayon-Cotton-Fabric Phenolic	Cross	1.37	17.6	6.6	1.9	32	34	25
High-Strength-Paper Phenolic	Cross	1.42	4.2	0.8	2.6	30	33	19
Grade AA Asbestos-Fabric Phenolic	Parallel	1.50	4.6	3.8	1.5	8	16	20
Glass-Fabric Unsaturated Polyester	Cross	1.82	31.5	9.9	3.0	43	53	42

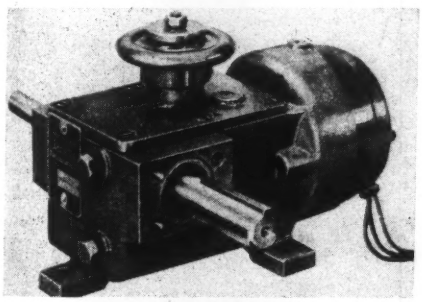
* All strength values are for the lengthwise direction of the sheet. The impact strength, flexural strength, and compressive strength measurements were made on ½-inch-thick material. The tensile tests were made on ⅛-inch-thick material.

NEW PARTS AND MATERIALS

For additional information on these new developments see Page 143

Motorized Speed Reducer

Developed especially for application to combustion control systems, type BO gearmotor uses double-reduction worm gearing to furnish output speed of 0.4006-rpm and approximately 220 lb-in. output torque. Speed reduction ratio is 4242.4 to 1. Driven by single-phase 115-v 60-cycle 1725-rpm capacitor-start capacitor-run motor, unit is instantly reversible up to 20 times per minute. Double output shaft is perpendicular to the input shaft. One side of the double shaft is provided for driving limit switch. Unit is equipped with 2½-in. handwheel to operate clutch for disconnecting motor and first reduction worm gear. Output shaft can thus be turned by handwheel to permit adjustment of driven apparatus. Manufacturer: Janette Mfg. Co., Chicago, Ill.



For more information circle MD 1, Page 143

Hard Facing Alloy

Bead deposited by EutecTrode 10 hardfacing alloy has a Rockwell hardness of 63-68C. Having high resistance to abrasion, this material is particularly suited to hard facing of roller cams, valve seats, pulverizing rollers and similar items. It will not become soft or lose strength at the temperatures encountered in these applications and gives smooth, dense deposits having good corrosion resistance. Available in ⅛, 5/32 and 3/16-in. diameter rods, alloy has FrigidArc coating which permits the hard surfacing of gray cast iron, steel, and malleable cast iron at low base metal heat. Manufacturer: Eutectic Welding Alloys Corp., 40 Worth St., New York 13, N. Y.

For more information circle MD 2, Page 143

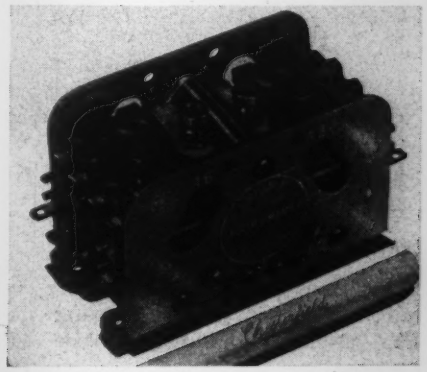
Push-Pull Controls

Basic elements of these push-pull controls are moving members enclosed in either rigid or flexible casing. Two types of linkage are available: No. 4 unit having ¼-in. OD for light-duty aircraft and industrial application and Nos. 5 and 7 units with 5/16 and 7/16-in. ID for applications requiring greater strength. Standard end fittings available are sliding rods with threaded, plain or hooked ends; clevis ends; quick-detach coupling units; ball and socket end fittings; radian units; friction locks; adjustable friction heads; and vernier head for combining adjustable friction head and friction lock with vernier adjustment. Controls operate at temperatures from —72 to 160 F. Manufacturer: Simmonds Aerocessories Inc., Industrial Products Div., 150-A White Plains Rd., Tarrytown, N. Y.

For more information circle MD 3, Page 143

Magnetic Contactor

Having the sensitivity of a polarized relay, redesigned type 6 sensitive contactor can be used in elaborate magnetic switch structures. Using three-position center-stable armature suspension, with or without differential windings, the contactor functions as output device for servo amplifiers, giving two-way response with only one relay. When adjusted for full-stroke armature motion, relay latches securely after momentary operation. Because it does not depend on mechanical catches and is immune to effects of vibration, it can be used as overload protector in electronic and communication equipment. Adjusted at high sensitivity with two-position spring-biased armature and controlled by low-power plate circuit, it can switch several power circuits directly. Manufacturer: Sigma Instruments Inc., 41 Ceylon St., Boston 21, Mass.

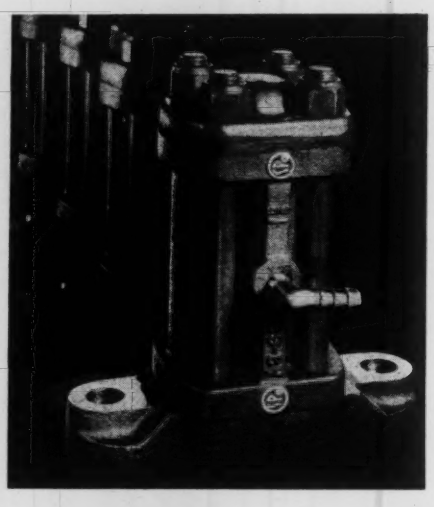


For more information circle MD 4, Page 143

Pneumatic Vibrators

Delivering impacts in a direction 90 degrees to material flow, series 81 pneumatic vibrators prevent contents of bins or hoppers from arching-over or plugging and insure steady flow through chutes. Designed for continuous or intermittent operation on equip-

ment handling powdered or granular materials, vertical-construction units can be mounted in any position. Corrosionproof bronze alloy cylinder liner is utilized to insure full-power start and high-speed operation. Cast semi-steel body and cast-steel mounting plate are used. Vibrators are available with 1⅝, 2 and 2½-in. diameter pistons and are equipped with either

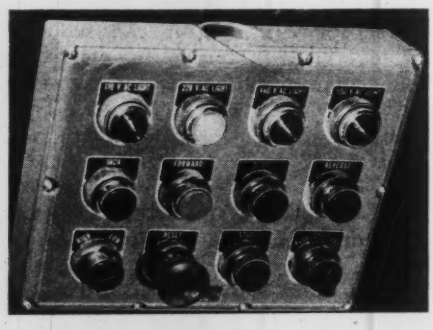


¼-in. rigid or swivel-type, straight or ell, connector for hose attachment. Manufacturer: SPO Inc., 6534 Grand Division Ave., Cleveland 5, O.

For more information circle MD 5, Page 143

Control Station

Designed for machine tool control and other heavy-duty installations, this 12-unit enclosure for type OT pushbuttons is an addition to the line of Oil-Tite control stations. Maximum interrupting capacity is 12 amp at 600-v ac, 60 amp at 110-v ac. Re-

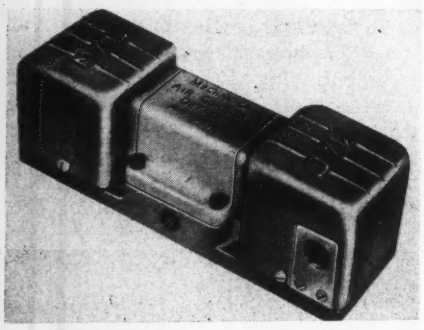


silient cork-neoprene gasket provides dependable seal against oil, coolant, cutting compound and water. Five types of operator heads with matching pilot lights insure unit flexibility. Units and nameplates can be rotated 90, 180 or 270 degrees to permit mounting in any position. Contact blocks can be mounted on base and terminals are reversible for front or rear connection. Die-cast zinc enclosure has baked enamel finish over Bonderized metal. Vibration-resistant bulbs are used for indicating lights. Manufacturer: Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

For more information circle MD 6, Page 143

Four-Way Air Valve

This momentary-contact double-solenoid four-way valve can be used for control of double-acting low-pressure hydraulic or air cylinders where the pressure is held on one side of the cylinder for a period of time. Basically used as a safety control, the valve is reversed by momentarily energizing a solenoid to hold the cylinder in a positive position without the necessity of holding either solenoid energized. Power failure will not reverse either the valve or the cylinder. The unit is available in ⅜ and ¾-in. full-orifice sizes with option of any size pipe taps in base.

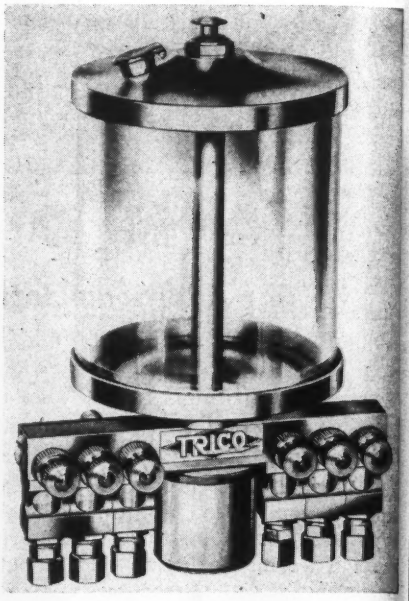


Only moving part is an aluminum alloy hard-chromed spool on which seals are mounted to give positive contact with body bores. Manufacturer: Mechanical Air Controls Inc., 5427 Hecla Ave., Detroit 8, Mich.

For more information circle MD 7, Page 143

Multiple-Feed Oilers

Controlled manually, or automatically by solenoids, this multiple-feed oiler forms a centralized system for lubricating one to 20 bearing points. Oil is fed by gravity from a large reservoir through individually adjustable needle valves and through copper or neoprene tubing to the bearings. When a solenoid located directly below reservoir is energized, oil feeds to all lines. Unit can be operated from any convenient current outlet or connected directly across motor-starting switch. Oil supply remains at constant level in master tube and sight-feed fittings show

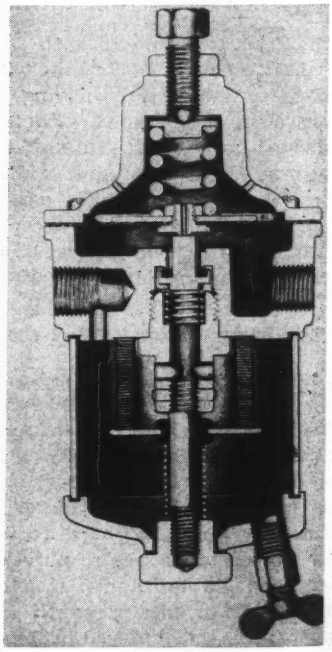


amount of oil being fed. Needle-valve assembly is ¼-in. above base of master feed tube to provide sediment chamber. Fittings and 1-pint, 1-quart or 2½-quart reservoirs are available in Pyrex glass or shatterproof Lucite. Manufacturer: Trico Fuse Mfg. Co., 2948 N. Fifth St., Milwaukee 12, Wis.

For more information circle MD 8, Page 143

Air Regulator-Filter

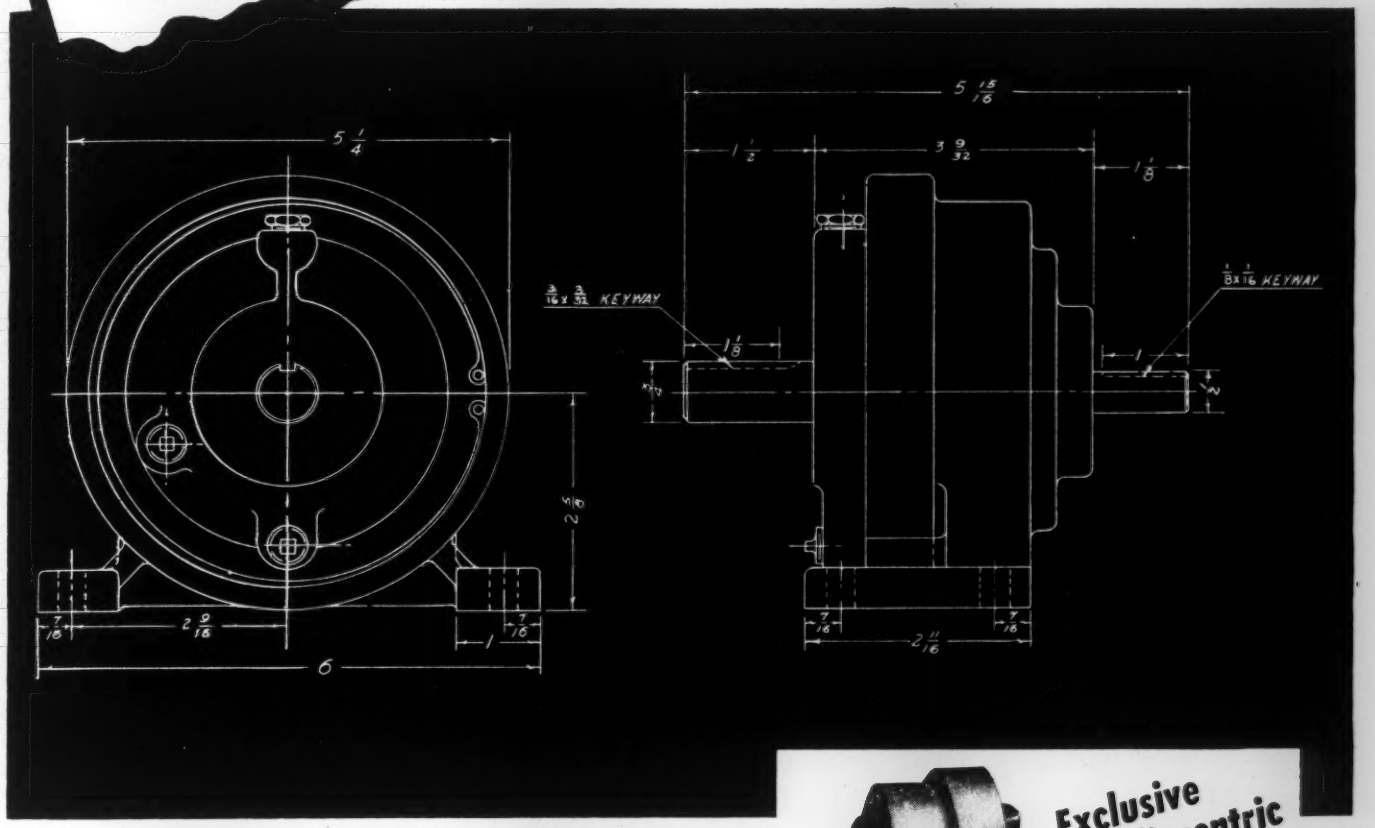
Available in 0-30, 0-60 and 0-125 psi outlet ranges, Cono Airpak combination regulator, filter and dripwell



operates at inlet pressures up to 150 psi. Other ranges can be supplied

Memo to MACHINE DESIGN READERS:

Save SPACE and COST by using this New Universal Speed Reducer in your design



Ratios available up to 1,000,000 to 1 for all in-line reducer requirements . . . 80 to 1 in single-stage units from ¼ to 1 horsepower

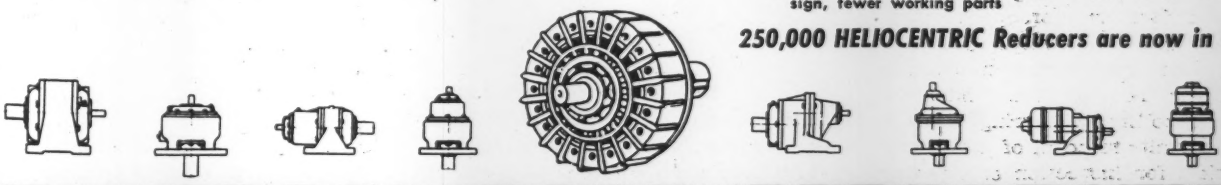
This new addition to the complete line of Universal Speed Reducers employs the exclusive *Heliocentric* principle—in which the load is distributed over 60 to 70% of the teeth at any one time (in the double-rack models)—while in conventional reducers every individual tooth must carry the entire load—must be built larger to withstand the same shock or impact loading.

Write today for complete information on the new Model 5-E or on the standard Universal line.

Check these specifications of Universal's new Model 5-E Heliocentric Speed Reducer against your requirements for compact, quiet, low-cost speed reduction:

- Maximum torque capacity—1000 inch-pounds
- Suitable for any installation with 1800 rpm input or less
- Straight-line reduction in a streamlined package
- Anti-friction ball bearings used throughout
- High efficiency at lower cost because of simplified design, fewer working parts

250,000 HELIOCENTRIC Reducers are now in service



UNIVERSAL GEAR CORPORATION

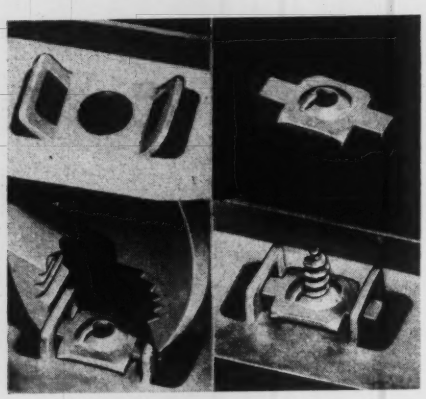
Specialists in Power Transmission Equipment · Indianapolis 7, Indiana

on special order. Constructed entirely of brass and stainless steel, the unit utilizes side-mounted drain cock which permits horizontal or vertical mounting without sacrifice of filter area or dripwell volume. Three ¼-in. NPT taps permit multiple reduced pressure connections and integral pressure gage mounting. Filter medium is phenolic resin impregnated cellulose capable of removing oil and water and particles down to 40 microns. Manufacturer: Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.

For more information circle MD 16, Page 143

Cage Nut

The P-1079 cage nut is locked in place by two prepunched loops that are quickly pulled up and over with ordinary pliers. Conical-shaped impression is formed in nut to provide

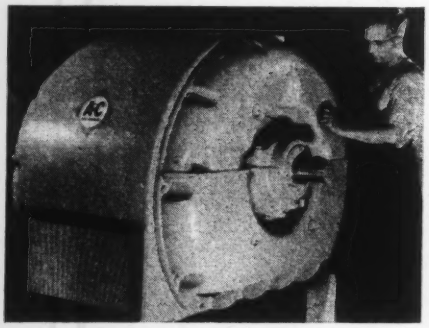


360-degree helical thread grip on screw thread. The snap-in nut employs one size cage to accommodate different panel thicknesses. Cage nuts are spring or mild steel, depending on torque requirement, and are available for most popular sizes of sheet metal screws. Manufacturer: Prestole Corp., 1337 Main St., Toledo 5, O.

For more information circle MD 17, Page 143

Induction Motor

Greater accessibility and protection are features of this redesigned standard line of squirrel-cage induction motors of four or more poles. Capsule-type sleeve bearings are employed, and split cast-iron bearing capsule or housing has machined flange for bolting to bearing bracket. Design permits removal of upper half of bracket for inspection or cleaning without exposing inside of bearing. Air-discharge openings in side of stator yoke, protected by removable louvers, facilitate vacuum cleaning or

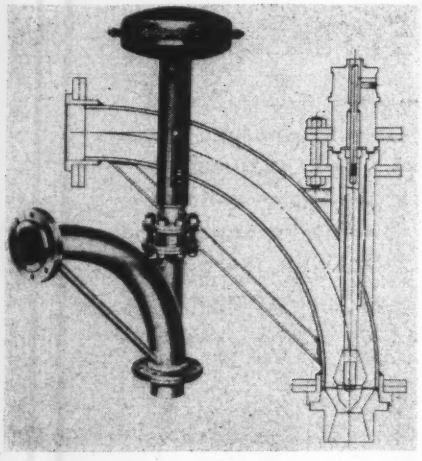


blowing out air passages behind stator core. Brackets also provide effective protection for ends of motor and help make standard design dripproof. Bracket-bearing squirrel-cage construction is standard for ratings up to 1 hp per rpm. However, for steady nonoverloading drives, such as centrifugal pumps and blowers, bracket-bearing construction can be used for ratings up to approximately 1.5 hp per rpm for motors in high-speed class up to 900 rpm. Motors are available with special electrical modifications to suit requirements. Manufacturer: Allis-Chalmers Mfg. Co., Milwaukee, Wis.

For more information circle MD 18, Page 143

Angle Valve

Standard spring range of 7000S series Flo-Tested valve is 3 to 15 psi although higher spring ranges for higher working pressures can be provided. Having long-radius-bend body, valve is designed to handle slurry and those liquids which must have mini-

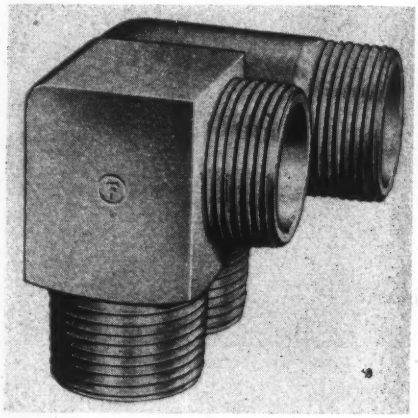


mum of turbulence in valve body. High-lift type valve plug is extremely long to assure ample guiding of valve plug even where it is operating very close to seat. Normal lift is half nominal valve size. One-piece seat is designed as section of Venturi throat and is lapped into valve body and retained by compression of line bolting. Because body has same cross-section as connecting line, maximum seat size is half nominal pipe area. Standard valve body bonnets are of solid barstock. Oilite bearings on stainless steel spring stem provide easy operation for vertical or horizontal position. Valve is available in sizes from 2 to 6 in. with body of carbon steel or type 304, 309, 316 or 347 stainless steel as standard. Manufacturer: Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I.

For more information circle MD 19, Page 143

Tube Elbow Fitting

Short-radius swing of Fluid Fortress tube elbow fitting permits close mounting in pumps, valves and cylinders. Illustration shows unit short



radius swing as compared to standard fitting in background. Ten sizes from ¼ to 1½-in. ID have radius swing of 25/32 to 2½-in. Single-piece steel connector body has tensile strength of 90,000 to 110,000 psi. Pipe threads are Dry Seal JIC type and machine threads are American National Form. Manufacturer: Flodar Corp., 331 Frankfort Ave., Cleveland, O.

For more information circle MD 20, Page 143

Geared Motor Drive

Incorporating both primary and secondary gear reductions, R3AC gearshift motor is designed to drive machinery that requires a low range of selective operating speeds and a high radial load capacity. It consists of an integrally mounted 5-hp 1200-rpm motor and a four-speed sliding - gear transmission. Output speeds of 123 to 1140 rpm are provided by selecting primary gear ratios of 4.15, 3.15, 1.85, and 1.00 to 1 and optional secondary gear ratios of 2.25, 2.06, 1.89, 1.74, 1.60, 1.48, 1.36,

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Just because you used catsup on your steak, the waiter shouldn't assume you use it on the rest of your dinner too!

And just because one bearing is best lubricated by one particular grade of oil, you shouldn't assume that the same oil is best for *all* bearings on that machine. In many cases it isn't.

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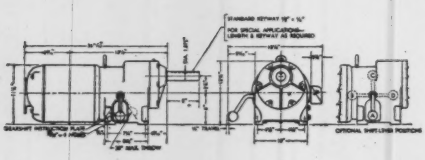


1.26, 1.17, 1.08, or 1.00 to 1. Unit operates on polyphase 25, 50, or 60-cycle power supply. Manufacturer: Lima Electric Co., Dept. AA 97, Lima, O.

For more information circle MD 9, Page 143

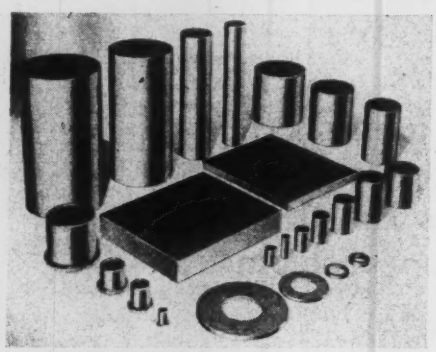
Nickel-Clad Copper

Having an electrical conductivity 70 per cent that of copper, this nickel-clad copper features corrosion resistance, strength and resistance to high-temperature failure. Conductor will not oxidize, flake or become brittle during beading, stem making, sealing or exhaust operations. It can be welded to molybdenum and tungsten as well as to itself. Conductor is available in ½ to 0.031-in. diameter rods; and in round and flat wire, coils or spools, solid or stranded in all commonly used sizes. Manufacturers: Alloy Metal Wire Co., Prospect Park, Pa.

For more information circle MD 10, Page 143

Oil-Impregnated Bearings

These all-purpose precision Bost-Bronz oil-impregnated bearings can be easily press fit in place and will not break or chip. Relubrication is accomplished by simply applying oil to the outer surface. Plain cylindrical bearings are stocked in ⅛ to 3-in. ID,

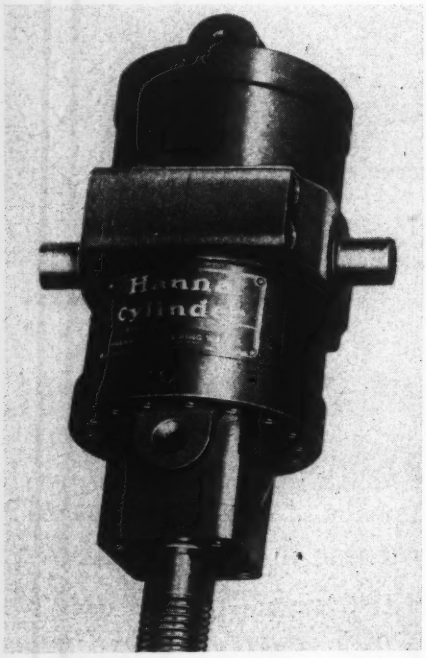


flanged bearings in 3/16 to 2-in. ID and thrust bearings in ¼ to 1½-in. ID. Also available are cored bar stock in range from ½ to 4-in. ID with 1 to 6-in. OD, solid bar stock from ⅜ to 4-in. OD and plate stock ⅛ to 1-in. thick. Manufacturer: Boston Gear Works, 64 Hayward St., Quincy 71, Mass.

For more information circle MD 11, Page 143

Hydraulic Cylinder

Push, pull, lift, press, clamp or control power for variety of applications can be supplied by model HP-17 hydraulic cylinder. It is designed for working pressures to 1500 psi. Eight standard mounting styles are available. Cylinder tube is centrifugally-cast Meehanite, accurately

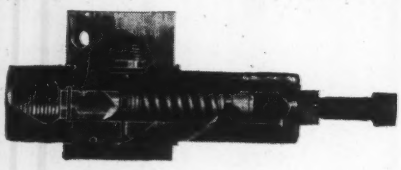


bored and honed. Ground steel piston rod has spring-backed packings. Cylinder heads can be rotated for varied port locations. For concentricity, steel piston is machined after assembly to piston rod. Rings insure minimum oil slip, and each cylinder head has four air vents. Self-sealing O-ring gaskets are used. Manufacturer: Hanna Engineering Works, Chicago, Ill.

For more information circle MD 12, Page 143

Flow Regulator

For cylinder speed control, model No. 320 adjustable flow regulator provides constant rate of flow regardless of pressure fluctuation or change in work resistance at any setting within adjustment range. Adjustable range is 50 per cent of calibrated flow rate measured in gallons per minute. Regulator is available for hydraulic systems with operating pressures to 3000 psi and will ac-



commodate ¼, ⅜, ½ and ¾-in. line sizes. Maximum controlled flow is 16 gpm. Manufacturer: Waterman Engineering Co., 721 Custer Ave., Evanston, Ill.

For more information circle MD 13, Page 143

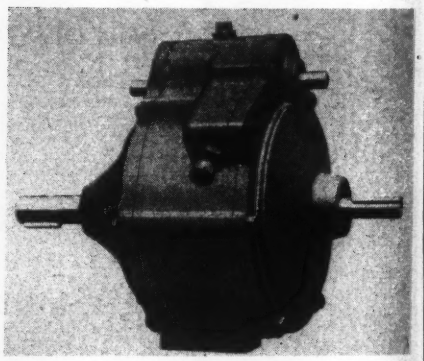
Packing Adaptors

Offered with a choice of either 90 or 100-degree included angle, RODgers bronze packing adapters can be used for air or hydraulic service. Outside and inside diameters as well as cross-sections conform to JIC standards. Stack or contact heights for both male and female adapters are the same as A-N standard stack heights for use with Vee packings. Manufacturer: Gilson Co., 75 E. Wacker Dr., Chicago, Ill.

For more information circle MD 14, Page 143

Speed Reducer & Clutch

Model No. 5107 reduction clutch has forward, reverse and neutral operating positions. It can be shifted or reversed frequently under full load. Minimum reduction ratio is 4 to 1. Having a capacity of 2 to 12 hp, the



unit measures 9⅜ by 9¾ by 10 13/16 in. Construction features include coincident shaft axes, roller bearing shafts, hardened pinions and cast iron housing. Clutch can be belt, chain or direct-connected to the power source or to the load. Manufacturer: Snow-Nabstedt Gear Corp., Hamden, Conn.

For more information circle MD 15, Page 143

Sensitive Relay

Normally high-speed in operation, series 1816 relay can be used for time delays from a fraction of second to 30 seconds or more by use of capacitors connected across the field. Standard coil is 15,000 ohms. Snap-action contacts are single-pole double-throw or double-pole double-thrown and are rated 15 amp. on 115 v. Other coil

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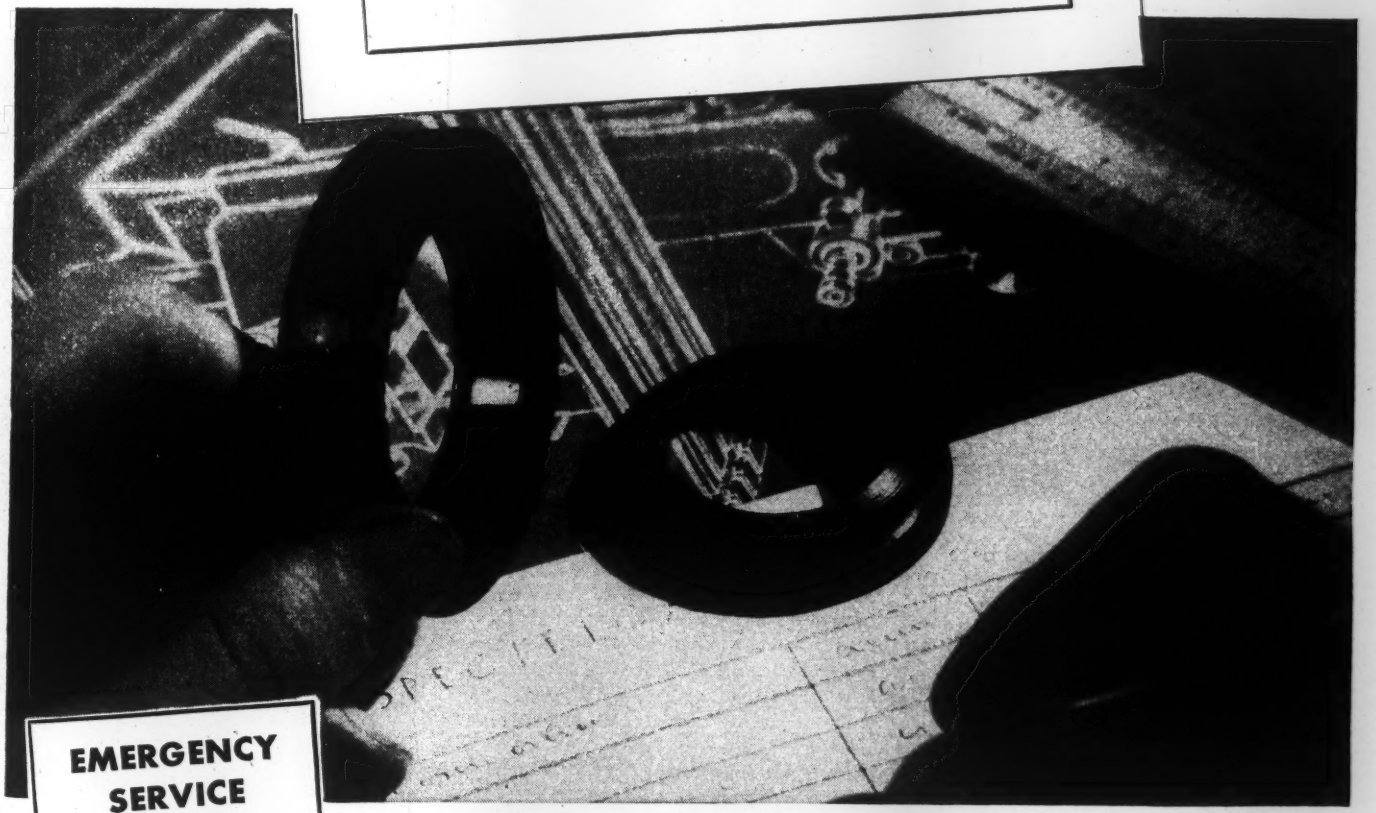
is cordially invited to make full use of Houghton's Packing Engineering Service when you need help in designing packing installations



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Yes, sir, if hydraulic design is your responsibility, and you desire advice on a packing installation, this is your invitation. Houghton hydraulic engineers have been doing that sort of first-aid for many years, which is one big reason why our packings are so well and favorably known. For proper recommendation of the right style of leather or synthetic rubber packings, contact E. F. Houghton & Co., Philadelphia 33, and all principal cities.

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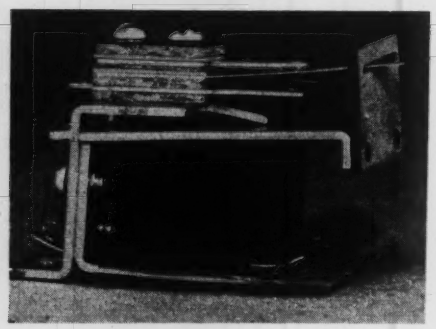
Engineered Packings

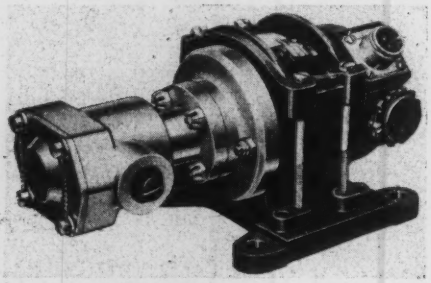


and contact combinations can be furnished. Coil is thoroughly impregnated against moisture. Relay can be mounted in any position. Overall dimensions are 1½-in. wide, 2½-in. long and 1¾ in high. Weight is 5 oz. Manufacturer: Assembly Products Inc., Chagrin Falls, O.

For more information circle MD 21, Page 143

Air Pump

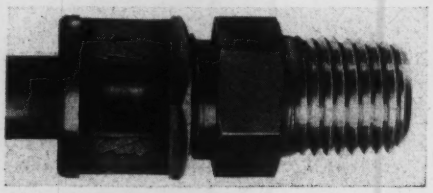
Positive-displacement rotary-vane type, Model C-10350 air pump is integral with motor and delivers ½-cfm of oil-free air. It has an inlet suction of 4 in. of mercury and outlet pressure of 1 in. The pump requires no external source of lubrication. It is designed to operate throughout an ambient temperature range of from −65 to 140 F. Manufacturer: Aro Equipment Corp., Bryan, O.



For more information circle MD 22, Page 143

Tube Fitting

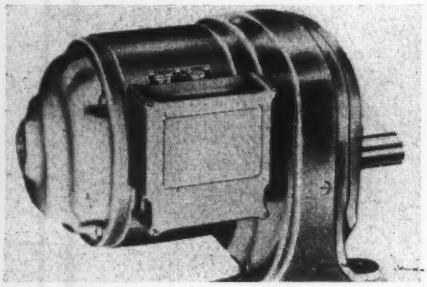
Designed for use with metal or plastic tubing, Swagelok clinch-type fitting provides leakproof seal at three points. Two ferrules and a threaded chuck clamp around the tube with virtually no effect on inner walls, thus allowing unimpeded flow of liquids or gases. Tubing need not be flared; fitting is slipped onto end of tube and tightened with a standard wrench. Fittings can be obtained in Monel, brass, aluminum, steel, or stainless steel for use with tubing from ⅛ to 1 in. OD. Manufacturer: Crawford Fitting Co., 21850 St. Clair Ave., Cleveland 17, O.



For more information circle MD 23, Page 143

Gear-Head Motor

Slow-speed geared electric power drives are single-phase capacitor type with single or double-reduction gears.

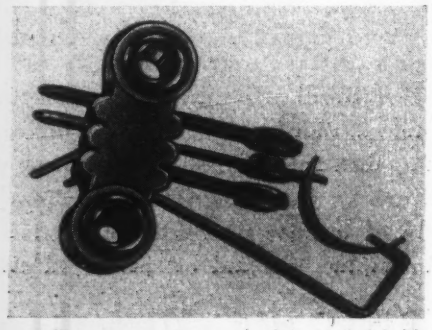


Speeds are provided from 780 down to 30 rpm in ratings from ½ to 3 hp. Utilizing newly designed starting relay which requires no rotating devices, motors have one-piece cast-iron stator frame, herringbone rotor and Vinolacetal-insulated wire stator windings. Manufacturer: Sterling Electric Motors Inc., Los Angeles, Calif.

For more information circle MD 24, Page 143

Snap-Action Switch

A midget unit for timing and sequence operations, model M-OM snap-action switch is of the open-blade type utilizing rolling spring principle. Contacts are rated 3 amp at 125-v ac. Contact arms and blades are held between molded Nylon or Melamine side members secured by eyelets capable of taking No. 1 mounting screw.

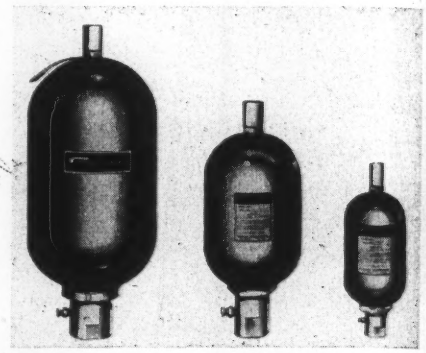


Contact points are pure silver. Manufacturer: Acro Mfg. Co., Acro Switch Div., Columbus 16, O.

For more information circle MD 25, Page 143

Hydraulic Accumulators

Offered in five sizes with capacities from 75 to 2050 cu in., these hydraulic accumulators are designed

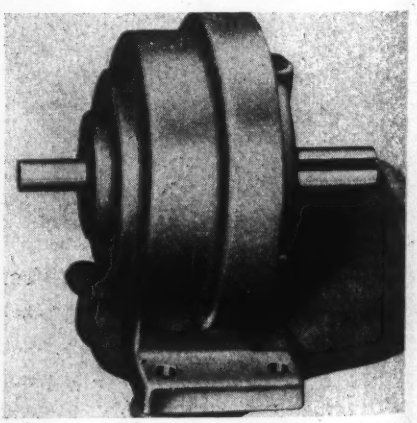


to supplement operation of vane or piston pumps in circuits with intermittent high-pressure requirements. High safety factor at 3000-psi is achieved by swedged neck connection and one-piece seamless alloy steel shell construction. Design follows practice recommended by JIC hydraulics standards for industrial equipment. Standard accessories, including gage and adapter assembly, precharging and gaging hose assemblies, are also available. Manufacturer: Vickers Inc., 1430 Oakman Blvd., Detroit 32, Mich.

For more information circle MD 26, Page 143

Speed Reducer

Suitatble for any straight-line installation in which input does not exceed 1800 rpm, model 5-E speed reducer serves ¼ to 1-hp range. Maximum torque capacity is 100 lb-in.

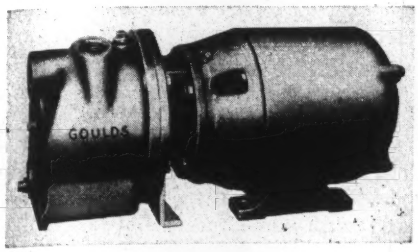


Features include antifriction ball bearings throughout, quiet operation, reduction in number of working parts, and high efficiency. Manufacturer: Universal Gear Corp., 19th & Martindale, Indianapolis 7, Ind.

For more information circle MD 27, Page 143

Self-Priming Pump

With efficiencies comparable to standard centrifugal pumps, these pumps offer the added advantages of positive self-priming, absence of large and bulky priming reservoirs,



and the elimination of recirculation of water during pumping stages. They are made in sizes from ¼ to 5 hp., open and closed impellers. Capacities range to 120 gpm with heads to 135 ft depending on capacity. Suction lifts to 25 ft are available. Manufacturer: Goulds Pumps Inc., Seneca Falls, N. Y.

For more information circle MD 28, Page 143

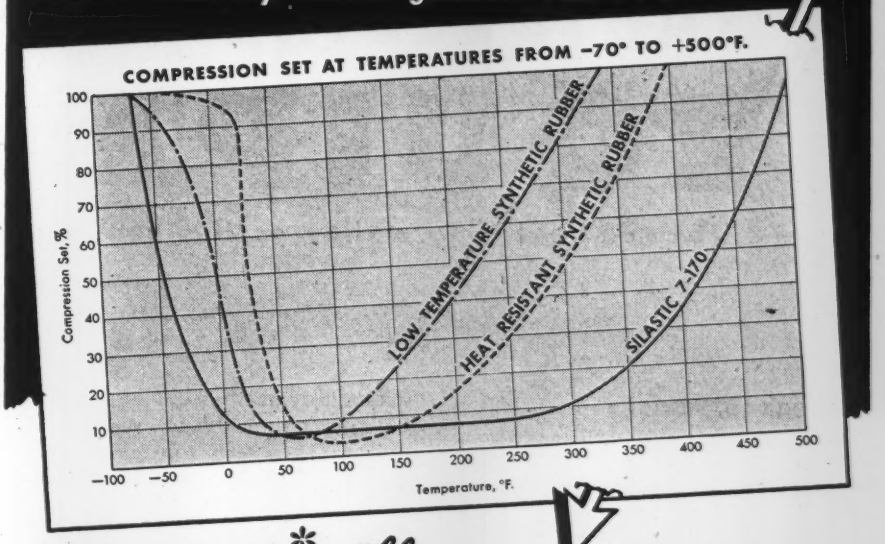
Sealed Relay

Relay 8744-1 has passed the tests and requirements of the Army Signal Corp and Air Materiel Command at Wright field. Its small size makes it suitable for all types of hermetically sealed requirements. Enclosure will accommodate 3-amp relays in con-

tact combinations up to and including four-pole double-throw. Measuring 17/16 by 1⅝ by 11/16-in., the unit has solder lug terminals and three stud mountings. Manufacturer: Advance Electric & Relay Co., 2435 N. Naomi St., Burbank, Calif.

For more information circle MD 29, Page 143

Where ordinary rubber gaskets fail . . .



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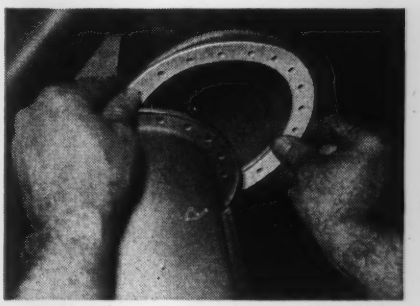

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In aircraft cabin heating and pressurizing systems, Silastic gaskets stay elastic under operating temperatures ranging from −70° to 400°F. Similarly, Silastic gaskets and O-rings withstand hot oils in the range of 450°F. in automotive, aircraft and diesel-electric engines.

COMBINE that kind of elastic memory with excellent resistance to aging, to oxidation and to attack by a variety of chemicals and hot oils, and you have Silastic—the most stable of all resilient gasketing materials. That's why design engineers and maintenance men specify Silastic, the Dow Corning Silicone rubber that pays for itself many times over in reduced maintenance costs and improved performance.

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ENGINEERING DEPARTMENT

EQUIPMENT

For additional information on this new equipment see Page 143

Electronic Tachometer

Frequencies up to 100,000 cycles per second can be measured by this high-speed electronic-counter tachometer with accuracy of plus or minus 1 cycle. Suited for high-speed turbine, engine and motor measurements, unit can be supplied with electromagnetic or photoelectric pickup devices for detecting speed without physical contact. Instrument totalizes number of counts measured during a time interval of 0.6-second and displays

it on a direct-reading four-digit electronic counter which uses ten neon glow lamps for each digit. After each measurement, the instrument automatically resets and recycles. Display time is adjustable over period of 0.5 to 4 seconds or can be set to hold count indefinitely. Time interval of 0.6-second is established by counting 60,000 cycles of 100-kc crystal oscillator contained in unit. Unit also incorporates count-rate meter which can be used to reflect instantaneous changes when unknown frequency source is being adjusted manually to specific point. Manufacturer: Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y.

For more information circle MD 30, Page 143

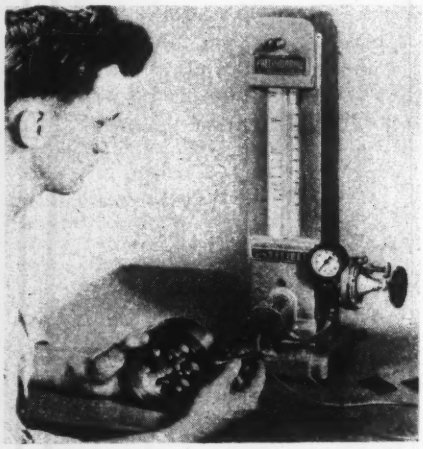
Transparent Negative Paper

Having a resolving power approaching that of film, Transaloid transparent paper negative material can be used for diazo reproduction, white prints and reproductions of tracings. It is usable without loss of detail in quantity production and can be used on line work and halftones up to 133 screen for making offset plates. Material has high contrast, good dimensional stability, wide range of latitude in exposure time, and high density emulsion on transparent water-resistant base. Being orthochromatic, material is sensitive to colors, is easy to opaque, and can be processed with standard developers and fixing baths. Cut sheets from 8 x 10 in. to 30 x 40 in. and rolls from 6 to 40-in. wide are available. Manufacturer: Haloid Co., Rochester, N. Y.

For more information circle MD 31, Page 143

Surface-Finish Comparator

Surface roughness on flat or curved surfaces having diameter greater than 3¾ in. and where roughness ranges from 30 to 500 microinches rms can be compared by Precisionaire surface finish comparator. Instrument shows reading which is actually a measure of air escape over a ⅛-in. diameter area. Repetitive

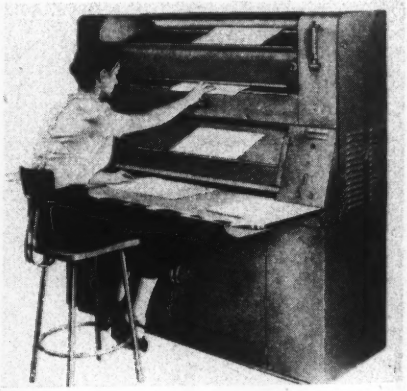


readings can be taken and compared with another finish or with selected standard. Requiring approximately a 6 by 6-in. bench area, the instrument can be attached to any plant air supply line or air compressor. Comparator is supplied with right-hand scale for 20 to 110 microinches, and with left-hand scale for 100 to 500 microinches. Sheffield Corp., Dayton 1, O.

For more information circle MD 32, Page 143

Whiteprinter

Employing dry ammonia-fume method of diazo reproduction and fluorescent light source, model D Versa-Liner whiteprinter accurately and clearly prints and develops blue line, black line, sepia intermediates, and other ammonia-type colored-line whiteprints. Unit uses 19 amp operating from standard 115-v 60-cycle supply. Mechanical torque-converter drive insures quiet speed control. Ammonia fume exhaust fan operates



independently, allowing evacuation of fumes when machine is shut down. Roll stock up to 42 in. wide and cut sheets can be handled. Printer speed is variable from 1/3 to 5 fpm; developer is set at 6 fpm. Heating element in developer can be adjusted within 40-degree range by means of dial-operated resistance coil to provide for processing different grades and weights of sensitized paper. Two-shelf front storage cabinet and oversize feedboard provide adequate working area. Manufacturer: Peck & Harvey, Dept. MD 5736 N. Western Ave., Chicago 45, Ill.

For more information circle MD 33, Page 143

KAYDON BI-ANGULAR ROLLER BEARINGS

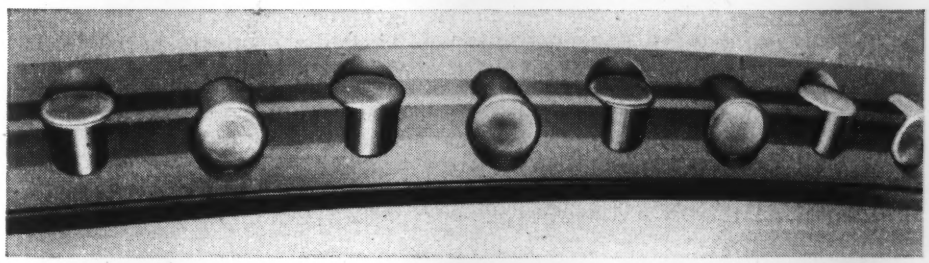
Does your bearing problem involve *both* thrust *and* radial loads? KAYDON BI-ANGULAR Roller Bearings are adaptable to various proportions of thrust and radial loads, as indicated below. These bearings are particularly suitable for low speed applications involving impact loads.

Whatever *your* bearing needs may be, KAYDON has *all* the facilities your engineers require. Whether you need only a few or many special bearings 4″ to 120″ outside diameter, or millions of high precision rollers, contact KAYDON for confidential counsel and cooperation.

ADAPTABLE TO EQUAL OR UNEQUAL THRUST AND RADIAL LOADS

For thrust loads *equal* from both directions, KAYDON BI-ANGULARS are made with every other roller reversed, as shown here. Adjacent rollers are at 90° angles to each other, permitting this bearing to take either radial loads or thrust loads, or a combination of both.

To handle heavy thrust load *greater* from one than the other direction, the bearing can be made with every second, third or fourth roller reversed, depending upon how relatively *unequal* the loads may be. Write for further detailed information.



31.000″ x 34.988″ x 2.000″ KAYDON BI-ANGULAR Roller Bearings have been produced in large quantities and are successfully in use. They are further proof of KAYDON ability to design and make unusually large, precision bearings for specific needs.

KAYDON Types of Standard or Special Bearings: Spherical Roller • Taper Roller Ball Radial • Ball Thrust • Roller Radial • Roller Thrust • BI-ANGULAR Roller

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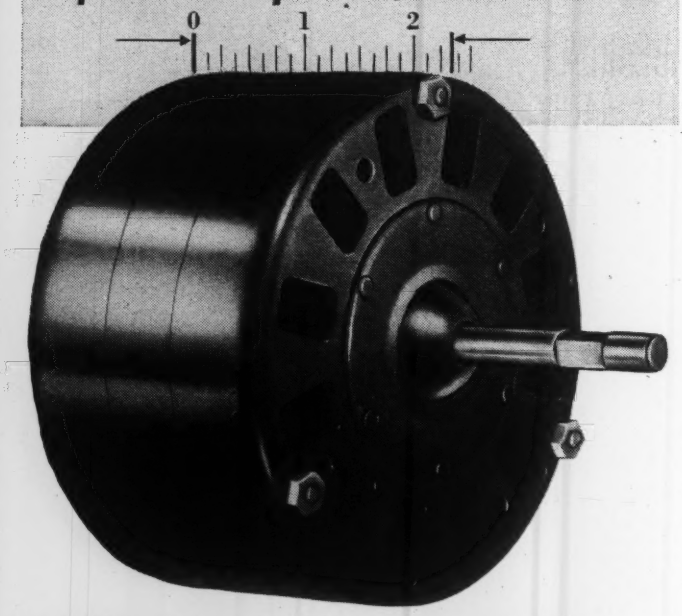

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★ Mounts to meet every need . . . interchangeable with other motors

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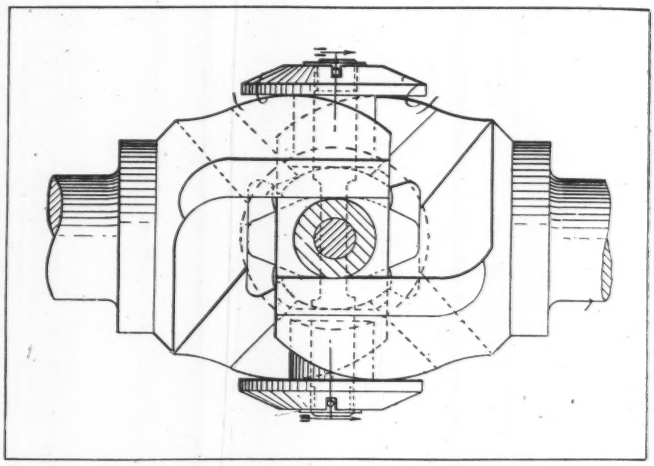
ROCHESTER 2, NEW YORK

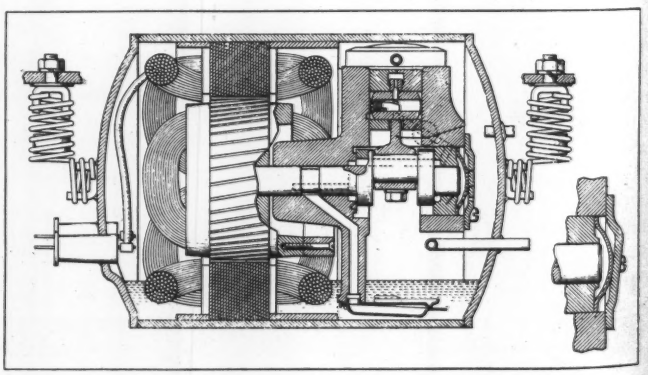
NOTEWORTHY PATENTS

CONSTANT-VELOCITY ACTION in a universal joint is obtained by using a cross-shaped member that holds the yokes on a fixed joint center regardless of the angle between the shafts. The cross, consisting of two trunnions centered in the joint by a spherical-



ball holding element, keeps the joint centered and eliminates the need for any external spherical housing. Tilting of either of the joint shafts about the joint centers causes a shifting of the trunnion cross to the bisecting angle to maintain the constant-velocity action. Universal Products Co. Inc. has been assigned the patent, No. 2,509,969, by George E. Dunn.

CRITICAL ALIGNMENT of motor, crankshaft and piston assembly in hermetically-sealed refrigerator units is maintained by using an adjustable clearance-compensating member on one end of the crankshaft and by providing rotor and crankshaft bearings integral with the one-piece compressor block. Correct



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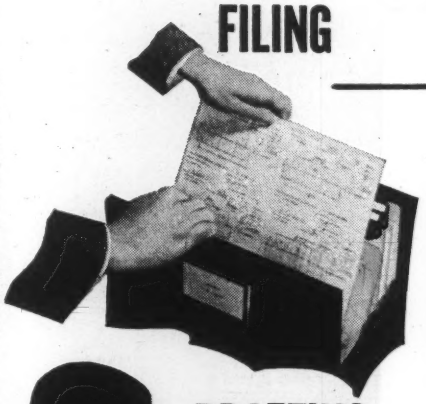
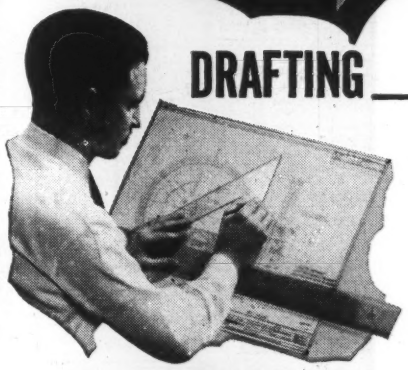


A low-cost, photographic intermediate paper that produced positive copies directly was "big news" for Crompton & Knowles, world's largest manufacturer of specialty looms. To begin with, it meant that they could reorganize their filing system much faster and much more economically than had been estimated. *Here was the problem:* they had some 200,000 detail drawings —4 to 8 on each sheet of paper. Many of these were not in sequence, which slowed reference; and, when blueprints of only one part were needed, it meant a waste of paper . . . besides taking the attached drawings out of the files. *Solution:* the design sheets were reproduced on Kodagraph Autopositive Paper; then the prints were cut and filed correctly in the "master" file.

★ ★ ★

DRAFTING



Crompton & Knowles has adopted the rule: *"A Kodagraph Autopositive intermediate of every drawing."* And this is paying off today in lower re-drafting costs. *Before,* the original detail drawings (described above) and scale drawings were used as the blueprint "masters" . . . were exposed to machine wear-and-tear, constant handling. When they no longer produced legible blueprints, they had to be redrawn. *Now* the valuable originals are kept safe in the files—available for reference and revisions only. The "Autopositives" do the "heavy work" . . . whenever needed.

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Using Kodagraph Autopositive intermediates, Crompton & Knowles turns out sharper, cleaner blueprints—at uniform, practical machine speeds.

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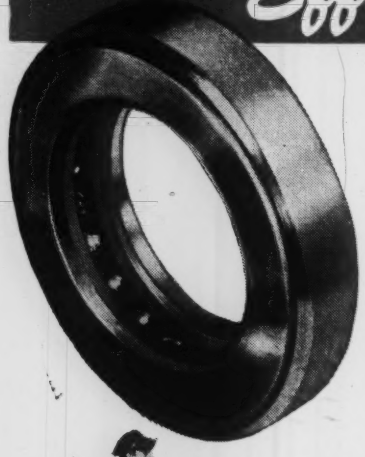

All industry knows Yale Lift Trucks as rugged workers that cut costs, speed production, handle all kinds of materials in volume—faster, safer, more efficiently.

Important contributors to their efficiency are the rugged ball thrust bearings in the trailing axle and wheel assembly—bearings specially designed to

meet the high load capacity, precision smoothness and long, trouble-free performance required in this tough application—bearings which Aetna has proudly supplied for over 15 years.

Improved performance, longer life and minimized maintenance are advantages which come to any hard working equipment when Aetna bearings lend a hand. Our engineers are ready and willing to work with you at any time.

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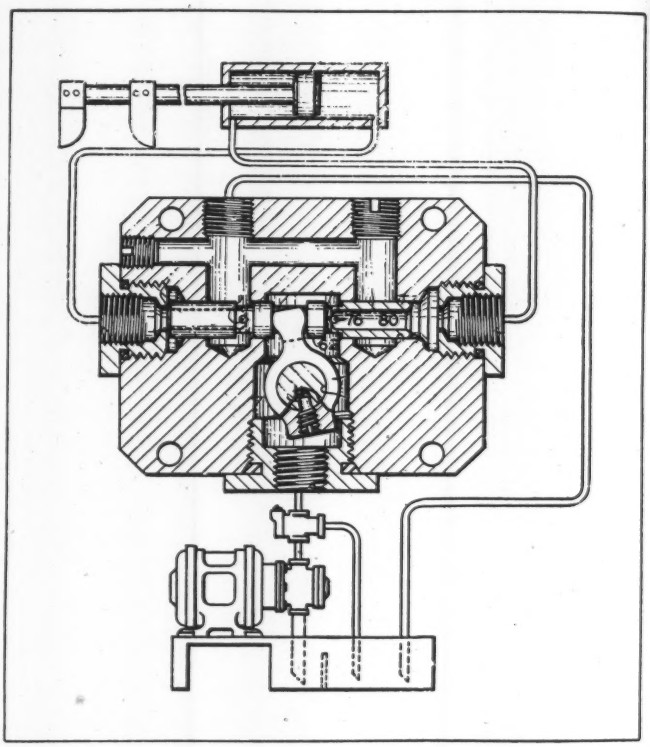
clearance between thrust bearings and shoulders of the crank throw is readily and accurately obtained on a large scale production basis by moving the crankshaft axially with a rotating, wedge-shaped cam or plate. In addition, a self-aligning wrist pin prevents binding of the piston in the cylinder. The patent, No. 2,504,747, has been assigned to General Electric Co. by Christian Steenstrup.

AUTOMATIC REVERSAL of a hydraulic cylinder is obtained without the use of a pilot valve in addition to the usual fluid-operated reversing valve. Patent 2,505,710 covers a unit that uses a mechanically



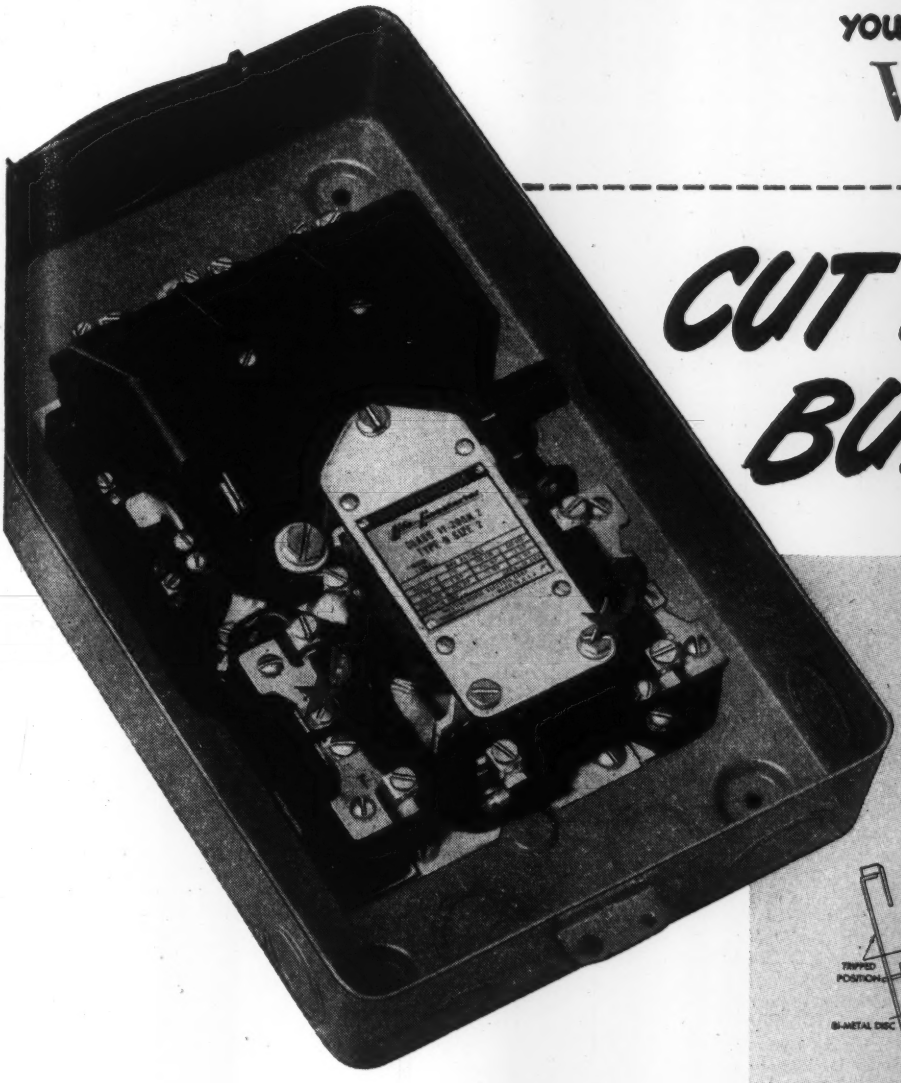
actuated toggle to move the valve spool direct, giving faster response. Mechanical movement of the spool is slight; once it is moved past the dead-center position, hydraulic pressure snaps the valve to full-open position. With the spool at dead center, both supply and exhaust lines to the cylinder are blocked to lock the table or other device being driven. Merrill A. Hayden has assigned the patent to Vickers Inc.

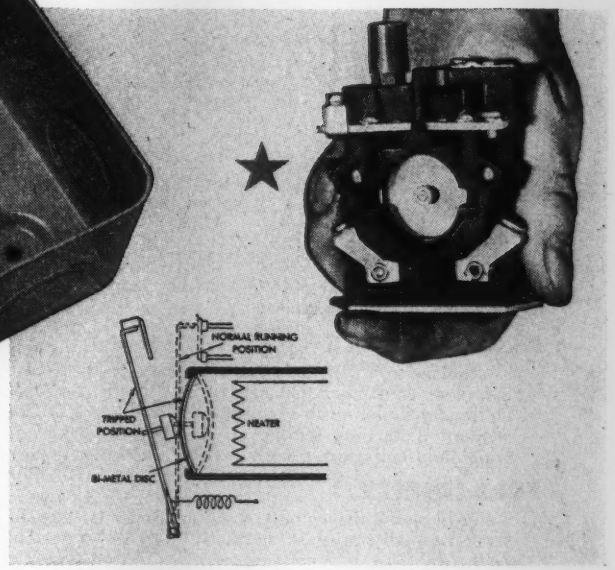
TELESCOPING NUTS eliminate backlash in power transmission screws as detailed in patent 2,498,897, where the power or table-drive screw is attached to the machine bed with an outer nut secured to the traveling member. Relative rotation between the outer nut and an adjusting nut (extending inside the outer nut for about half its length) removes all backlash between the nuts and the power screw. Kurt A. Riedel has assigned the patent to Kearney & Trecker Corp.

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

CUT MOTOR BURNOUTS





with the *Life-Linestarter** ... positive protection against overloads

Stop worrying about the inconsistencies of ordinary overload relays.

Investigate the new Westinghouse Life-Linestarter with the bi-metal DISC overload relay which provides a positive contact pressure, with snap action. It retains its precise calibration regardless of the number of operations. It's the only relay that may be set for "automatic", "hand" or "no-stop" operation.

Positive protection is but one of the advanced features offered by the new Life-Linestarter. It's best because of its uniformity and completeness of line (NEMA sizes 0 through 4, to 100 hp, 600 volts), superior performance, ease of installation and other cost-saving advantages.

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Ask your nearby Westinghouse representative for the "inside story"—a Trans-Vision presentation—at your convenience. Or write for booklet B-4677. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-30024

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SIZE

Non-Reversing

2 to 4 Pole 2-3/4" w. x 3-5/8" h. x 3-5/16" d.
5 to 8 Pole 5-9/16" w. x 3-5/8" h. x 3-5/16" d.

Reversing

2 to 4 Pole 5-9/16" w. x 3-5/8" h. x 3-5/16" d.

Note: 10 and 15 ampere contactors have same mounting and overall dimensions.

ACCESSIBILITY

To replace contacts, it is not necessary to disassemble the complete contactor. Just remove the parts comprising the stationary and movable contacts. Contacts can be replaced without disturbing wiring. To change coil, remove magnet frame and coil assembly only. (See illustration below.)

FLEXIBILITY

Using a screw driver only, you can easily change any pole from normally open to normally closed. No special parts required. 10 and 15 ampere parts are interchangeable.

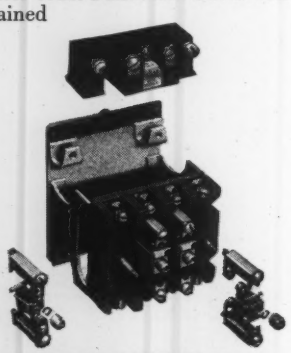
RELIABILITY

Laboratory tests involving millions of operations, plus field service of thousands of R-B-M contactors on door operators, radio transmitters, packaging and weighing machinery, hoists, machine tools and many other industrial applications offer proof of dependable, trouble-free performance.

ADVANCED DESIGN

Melamine Insulation. Molded coil housing. Ilsco solderless connectors. 50/60 cycle magnet coils. Palladium silver contacts. Stainless steel self-contained contact springs.

Where space is a factor, and accessibility a must—use R-B-M industrial contactors. Initial low cost plus dependable performance will save you money. Write for Bulletin 600 and price list on your company letterhead.



Dept. B-10, R-B-M DIVISION OF ESSEX WIRE CORP.

RBM

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MANUAL AND MAGNETIC ELECTRIC CONTROLS
—FOR AUTOMOTIVE, INDUSTRIAL, COMMUNICATION AND ELECTRONIC USE

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Metals at High Temperatures

By Frances Hurd Clark, U. S. Navy Material Catalog Office; published by Reinhold Publishing Corp., New York; 372 pages, 6 by 9 inches, clothbound; available through MACHINE DESIGN, *$7.00 postpaid.*

Investigation of the high-temperature properties of metals and alloys has been stimulated in recent years by the demands of gas turbines, turbojets, rockets, projectors, gun barrels, etc. Designers concerned with high-temperature applications must rely upon results of these investigations since there is no adequate analytic description of the behavior of metals at temperatures approaching the melting point.

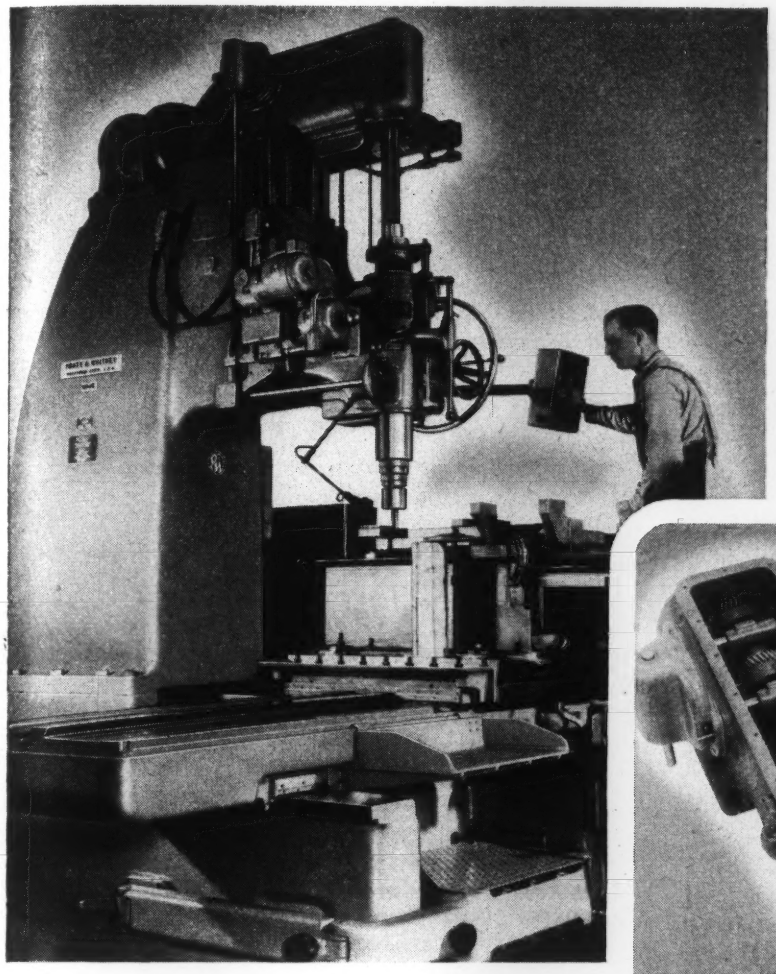
This book is a compilation of high-temperature data accumulated from many sources. Primary attention is directed to plain-carbon steels, alloy steels and the special heat-resistant alloys (Co-Ni-Cr-Mo, etc.) developed for turbine applications. Information is also given on lower-melting alloys, especially Al and Mg alloys. All essential data are presented in convenient tabular form.

The text is introduced by a theoretical discussion on the plasticity of metals with special reference to high-temperature effects. A full discussion is devoted to the phenomenon of creep in metals and alloys. There are also sections on test methods for materials at high temperatures and on current manufacturing methods for heat-resistant alloys.

Manufacturer and Association Publications

Modern Refractory Practice—Third Edition: Rewritten and enlarged, this book presents comprehensively engineering data on refractories and their applications. Copies of the 439-page, 8 by 10½-inch, clothbound book may be obtained from the Harbison-Walker Refractories Co., Pittsburgh, Pa., for $6.00 each.

Power Press Handbook: Designed for use by those engaged in the pressed-metal industry, this 700-page text includes sections on: primary sheet metalworking operations, types of equipment used to perform these operations, methods of computing press capacity and blank size for various types of work, selection of the proper press for a given job, and a comprehensive glossary of terms used in the industry. The book is priced at $7.50 and may be obtained from the E. W. Bliss Co., Handbook Dept., Toledo 7, O.



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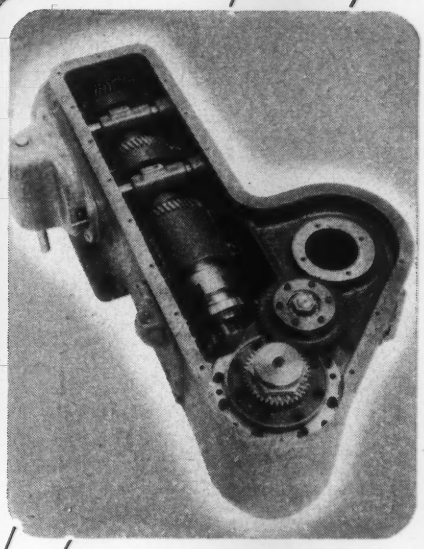

Pratt & Whitney Model 4E Jig Borer.

Inset: View of Twin Disc MTU Duplex Clutch in the gearhead.

. . . with a Twin Disc Clutch

It takes real *precision* to locate and bore holes with an accuracy of *.0002"*. But Pratt & Whitney's new Model 4E Jig Borer does it. A 15-ton example of accuracy, stability and fine workmanship, this machine utilizes a 4½" Twin Disc MTU Duplex Clutch and brake combination in the gearhead.

Built to "wear like a bearing and perform like the best friction clutch" . . . that's the standard to which Twin Disc machine tool clutches are held. In addition to compactness, high torque capacity and long wear-life, Twin Disc Clutches feature ease of operation and single point adjustment. No wonder precision manufacturers like Pratt & Whitney think of Twin Disc when their design calls for *accuracy.*

For more information on Twin Disc Machine Tool Clutches see your nearest Twin Disc dealer or write for Bulletin No. 134-A.

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CLUTCHES AND HYDRAULIC DRIVES

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Dynamic Balancers

(*Concluded from Page* 106)

Because

$$\omega_o = N_o \frac{2\pi}{60} \quad \ldots\ldots (38)$$

and by use of $g = 386$ inches per second per second and Equation 34, Equation 37 becomes

$$\tan \beta = \frac{d N_o^2}{33{,}500} \quad \ldots\ldots (39)$$

This equation may be used to determine the angle, β, in any particular design.

From the geometry of *Fig.* 12

$$D = 2r + d \quad \ldots\ldots (40)$$

Substituting for r from Equation 35 gives

$$D = 6d \quad \ldots\ldots (41)$$

It is obvious from *Fig.* 12 that when six balls are used

$$a = d \quad \ldots\ldots (42)$$

Also, from the geometry of *Fig.* 12, the capacity of the balancer may be calculated in terms of ball diameter. For six steel balls the capacity, in pound-inches, is

$$\text{Capacity} = 1.75\, d^4 \quad \ldots\ldots (43)$$

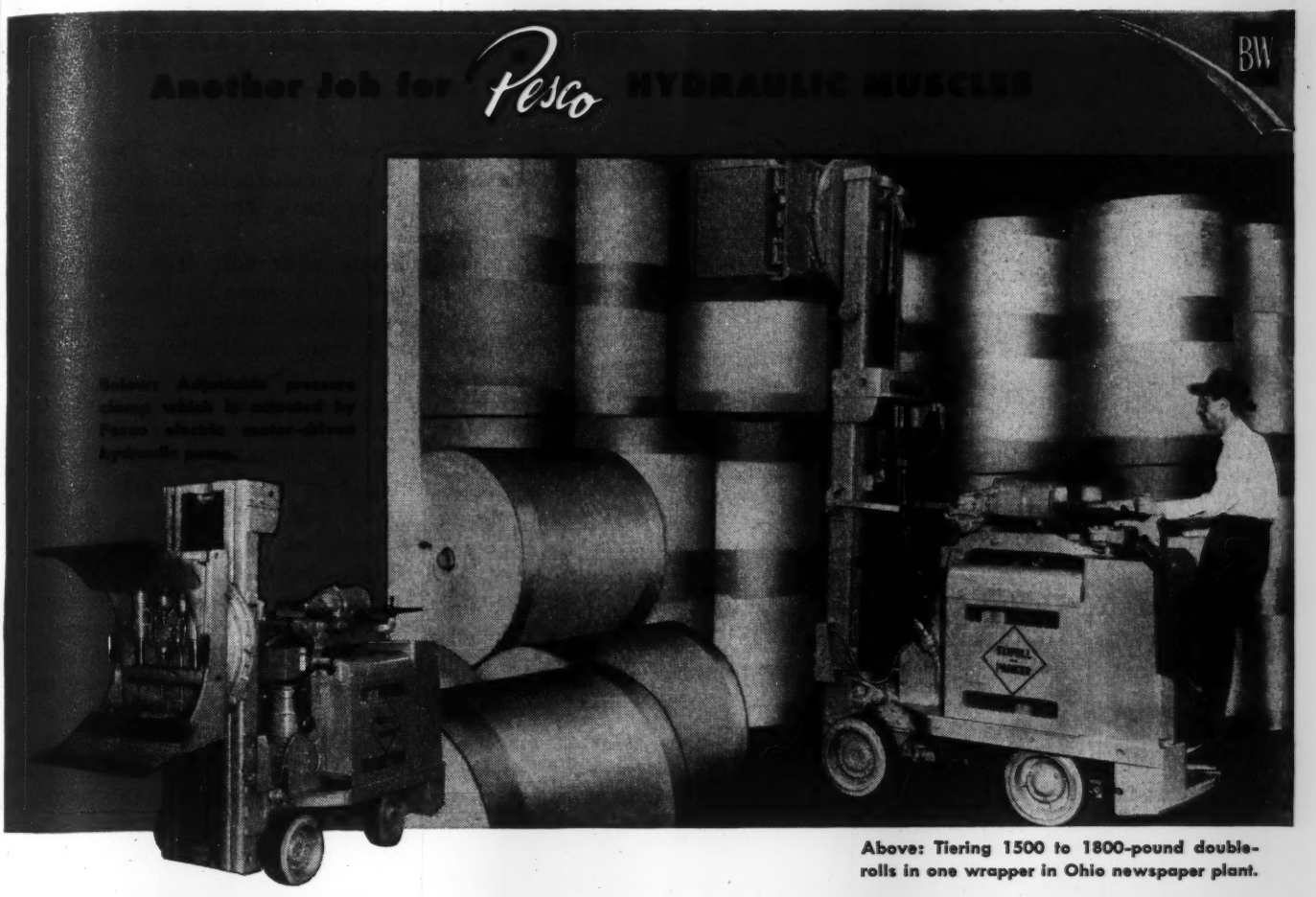
Equations 39, 41, 42, and 43 give all basic quantities necessary for the design of a six-ball balancer of this type.

The ball balancer does not meet all requirements of the ideal automatic balancer as listed in Part 1 of this series. Although it is practically 100 per cent effective in eliminating oscillation of the rotating system above the critical speed, it cannot easily be placed in the plane of the unbalance. There is therefore, an unbalanced reaction in the plane of the elastic mounting of the system, as discussed in Part 1. Also, the ball balancer is not operative at speeds near and below the critical. It therefore does not help the rotor pass through the critical speed.

This series will conclude with a discussion of a simple device which meets all requirements of the ideal automatic balancer.

They Say...

"Although today's automobiles are the best ever built, tomorrow's will be far superior. While the car of 1959 may not be powered by atomic energy, it is quite likely to have under its hood a small, simple, and extremely economical gas turbine. In any event, it will be as far ahead of the car you are now driving as this year's models are ahead of the cars of 1934"—G. T. CHRISTOPHER, *Packard Motor Car Co.*



Above: Tiering 1500 to 1800-pound double-rolls in one wrapper in Ohio newspaper plant.

HEAVY rolls of paper handled easier, faster

. . . with new Elwell-Parker, Pesco-equipped Clamp Truck

This Pesco hydraulic motor has displacement of 1.92 cu. in. and develops 4.4 hp. at 1000 p.s.i. at 1200 r.p.m.

Capacity of this Pesco electric motor-driven pump is 1.6 g.p.m. at 1450 p.s.i. at 27 volts d-c.

Savings up to 75 per cent in time—savings in storage height and the ability to "nest" paper rolls weighing up to 3500 pounds are some of the advantages of this new Clamp Truck.

Two Pesco units help to make these savings possible. A Pesco electric motor-driven pump moves the clamp that grasps the paper roll and holds it firmly, but without damage to the paper, while stacking. And a Pesco hydraulic motor provides the power that rotates the clamp mechanism so that the rolls may be stacked on end or laid on their sides.

The preciseness, ease and speed with which Pesco hydraulic muscles handle heavy, awkward loads is only one of many important reasons why more and more industrial equipment manufacturers are turning to Pesco for answers to their hydraulic power problems.

For the complete story of how the sales power of Pesco Pressurized Power can help you, write today.

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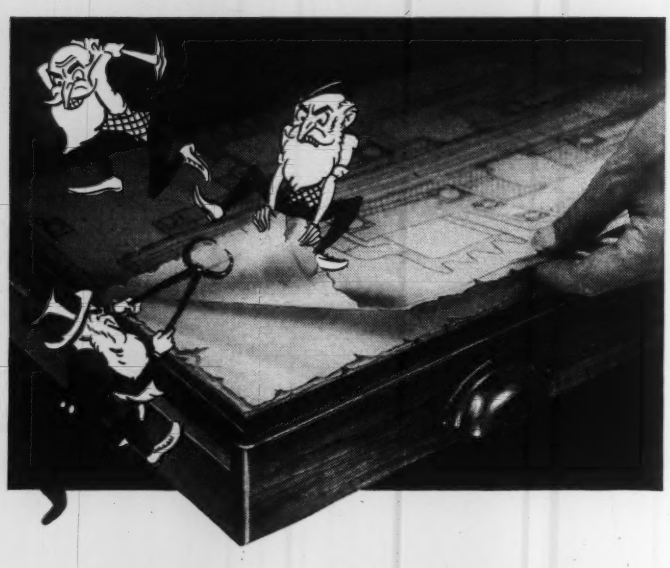

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AMERICA'S STANDARD FOR OVER 25 YEARS

Eddy Current Clutch Servo

(*Concluded from Page* 115)

shaft, a floating assembly was made. Two cups transmit torque to the nonmagnetic disk and are free to float since they have their own separate center of rotation.

First tests were made with soft iron coils and cups. These would eventually seize on the soft iron magnetic poles under severe operating conditions. Next, cast iron sleeves were used. This eliminated the seizing trouble and gave excellent torque values, but showed slight residual magnetic effects. This means that under no-load condition the clutch continued to rotate in the direction of the rotation of the last coil which had been energized.

Preliminary tests with soft steel sleeves, chromium plated, *Fig.* 9, indicate excellent results in every respect, as shown in the curves, *Figs.* 10 and 11. Torque-speed curves of the eddy current clutch with chromium-plated sleeves are shown in *Fig.* 10. These values were measured with only one clutch side energized. The motor speed of the clutch servo unit is 5800 rpm nominal. To obtain slip speed inside the clutch, subtract the output speed from the motor speed (5800 rpm) when the clutch drives the output shaft. With the clutch braking the output shaft, add the two speeds in order to obtain slip speed. Torque-speed curves are particularly interesting since the slope of these curves determines the operating points at which this device in push-pull operation will be stable or unstable in a servo application.

Output power is calculated from the output speed and output torque, *Fig.* 10. Dissipated power is calculated from slip speed and output torque, which is the same as the slip torque. The clutch operating as a brake dissipates considerable heat. Braking at 4000 rpm with 40 ma excitation current developed sufficient heat to break the soft-soldered connection of the clutch-coil. Of course, in actual servo applications this manner of operation will occur only momentarily and will not last long enough to damage the unit. Torque versus excitation curves for various driving and braking speeds are given in *Fig.* 11.

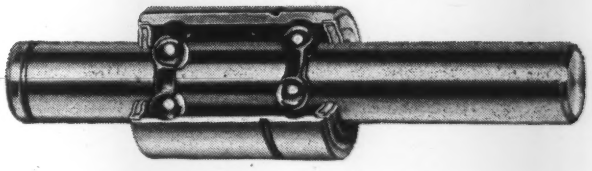
From the curves of the single unit it is easy to predict the operation of two units opposed to each other. The clutch with the cast iron sleeves has slightly higher torque values and more time delays due to magnetic hysteresis effects.

The clutch-servo has, for its size and the low values of its excitation current, a high output torque and, in addition, permits speed regulation. Also, inertia of the output shaft is small. The shape of the torque against exitation curves bears out qualitatively the theoretical calculations.

REFERENCES

1. A. S. Gutman—"Eddy Current Servo Clutch," CFS Report No. E5031, Nov. 1948, Cambridge Field Station, Cambridge 39, Mass.
2. R. Rüdenberg—"Energie der Wibelstrome in Elecktrischen Bremsen und Dynamonaschinen"; Stuttgart, Union Deutsche Verlagsgesellschaft, 1906.
3. M. Abraham—"Theorie Der Elektrizitat", Vol. 1; Leipzig, B. G. Teubner, 1904.

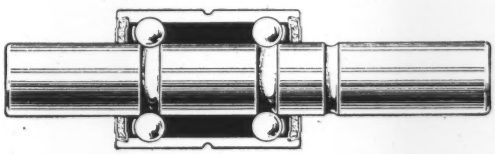
This versatile ball bearing



may cut assembly and materials costs in your application, too

If you are using prelubricated, sealed bearings with shafts that require flats, keyways, threads or multiple diameters—and your loads fall within the limits shown in the table—you will find many advantages in using a Federal Shafted Ball Bearing.

Take a good look at its compact design: Two rows of balls—equal in capacity to two single-row bearings—are held in a *single outer ring*. The *shaft itself* is the inner ring, and can be furnished with flats, keyways, threads or multiple diameters. Effective felt seals keep the grease permanently *in* and the dirt *out*.



RADIAL LOAD RATINGS IN POUNDS								
R.P.M.	500	600	800	1000	1500	2000	3000	5000
	630	600	550	510	450	415	365	315

Pure thrust may be taken as 20% of radial capacity.

Manufacturers have put these design features to work in a variety of applications—eliminated the expense and time required for boring parallel housings for the two bearings and manufacturing separate shafts. For example:

In home workshop equipment, this single unit, pressed in a die-cast housing, produced a more compact, streamlined product at lower cost. Complicated bearing housings and shaft production were eliminated.

Assembly of idler pulleys was simplified with a formed steel pulley pressed on the outer ring and mounted on the shaft in the machine frame.

In a space ventilating and heating unit, a single shafted bearing replaced two bearings and a shaft.

Federal engineers will be glad to help you adapt this versatile bearing and design a shaft for your individual needs.

Our 260-page catalog "K" gives complete specifications for these and all other bearings in the *complete* Federal line. More than 100 pages of engineering data contain load-rating tables to help you select the right bearing for every anti-friction need. Write for catalog today. Also write for a copy of our latest Ball Bearing Conversion Tables which contain complete up-to-date interchange information.

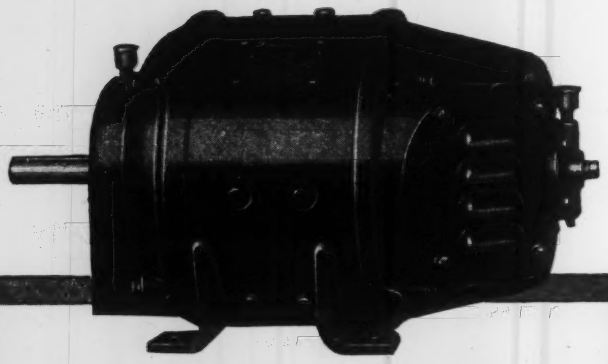
THE FEDERAL BEARINGS CO., INC., POUGHKEEPSIE, NEW YORK

Makers of Fine Ball Bearings

Quality since 1908

FEDERAL BALL BEARINGS

ONE OF AMERICA'S LEADING BALL BEARING MANUFACTURERS



ALL PEERLESS MOTORS ARE

"Peerless Registered"

MORE than 90% of all Peerless Motors are custom manufactured to meet the specific operating requirements of the equipment with which they are to be used.

So we "Peerless Register" every motor before shipment. The words "Peerless Registered" are a trademark, recorded in the U. S. Patent office. Only Peerless Motors can bear this phrase, and only Peerless Motors offer you this protection.

This registration record is assurance to both you and your customer that the Peerless Motor has been properly designed for your equipment so as to give best possible performance and long, satisfactory service. And the registration record makes possible the quick identification of any Peerless Motor — anywhere.

THE PEERLESS ELECTRIC CO., WARREN, OHIO

Manufacturers of Quality Motors Since 1893

Single Phase • Polyphase • Direct Current • ¼ to 15 H.P.

ALL Peerless Motors ARE "PEERLESS REGISTERED"

SOCIETY ACTIVITIES

The Oxy-Acetylene Flame—Master of Metals is the title of a new 20-minute motion picture on oxyacetylene welding and cutting. Produced in sound and color, the film represents the co-operative effort of the **International Acetylene Association** and the United States Bureau of Mines. The film explains what the oxyacetylene processes are and can do. Requests to borrow copies of the film should be addressed to the Supervising Engineer, Graphic Services Section, Bureau of Mines Experiment Station, 4800 Forbes St., Pittsburgh 13, Pa. Request for film purchase information should be directed to the Secretary, International Acetylene Association, 30 East 42nd St., New York 17, N. Y.

♦

The **Society for Advancement of Management** has announced the following slate of new national officers elected by unanimous vote for the 1950-51 fiscal year:

President
Dillard E. Bird, Management Counsel, New York City

Vice President
Leon J. Dunn, assistant to the vice president, Veeder-Root Inc.

Secretary
Howard K. Hyde, Department of Defense, Washington, D. C.

Treasurer
Bruce Payne, president, Bruce Payne & Associates

Mr. Bird was re-elected to the office of president after administering a record-breaking 1949-50 year marked by a personal tour of the Society's 50 local chapters during which he presented more than 91 speeches.

The SAM concerns itself with the advancement of all major functions of management—production, distribution, finance, industrial engineering management, and industrial relations.

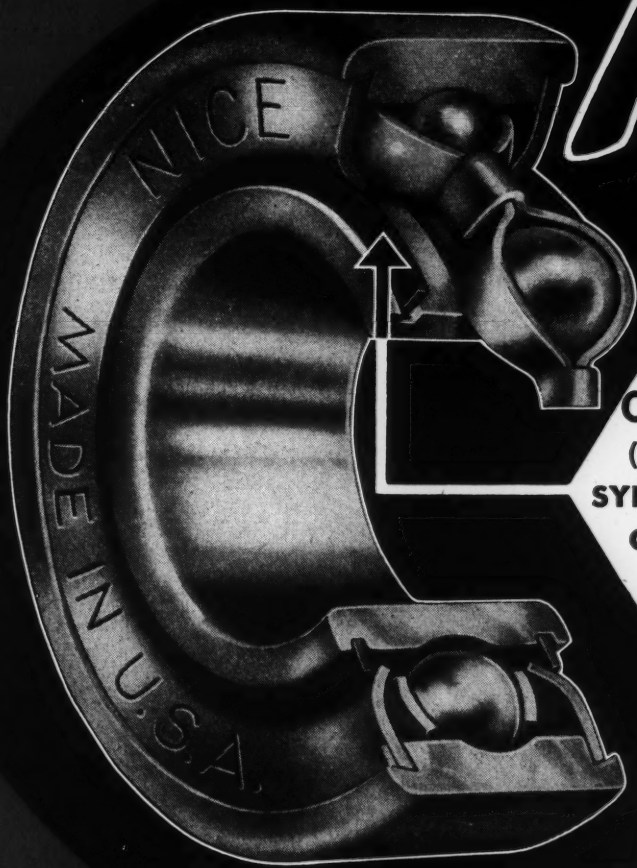
♦

The **Instrument Society of America** has produced a film, *Principles of Automatic Control,* which will be used to present the subject of automatic controls to executives, production supervisors and operators, technical personnel, and students. The two-part film, in color and with sound, has a running time of 55 minutes.

♦

C. O. Burgess, technical director of the Gray Iron Founders' Society, Cleveland, O., has been appointed vice-chairman of committee A-3 on cast iron of the **American Society for Testing Materials.**

NICE...and NEW!



COMPOSITION SEAL*
(OIL RESISTANT SYNTHETIC RUBBER COATED FABRIC)
***PATENT APPLIED FOR**

Series 1600 (Ground) and 3000 (Unground), Composition Sealed. Also Available With or Without Plate Shields.

For the Product Designer and Product Manufacturer, an *important new* addition to the NICE line. Field tested and proven highly successful, the NICE COMPOSITION SEAL design effectively retains lubricant and excludes foreign material.

WRITE FOR NEW CATALOG NO. 140

NICE

NICE BALL BEARING COMPANY
NICETOWN · PHILADELPHIA · PENNSYLVANIA

NEW—

a Mighty Midget Built for Millions of Operations

semi-knife-edge bearing reduces frictional wear

This is Ward Leonard's new Bulletin 110 Midget Relay for long, trouble-free service, particularly in equipments subject to vibration.

Exceptionally good vibration characteristics are due to proper proportioning of contact masses and springing combined with heavy pressures on both normally open and normally closed contacts.

Higher contact ratings than most midgets. Available up to 3-pole, double throw. Contact finger leads are insulated with the new, impregnated glass-fiber tubing.

Write for Bulletin 110. Ward Leonard Electric Co., 58 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

WARD LEONARD ELECTRIC COMPANY

Result-Engineered Controls

RESISTORS • RHEOSTATS • RELAYS • CONTROL DEVICES

NEWS OF MANUFACTURERS

The **B. F. Goodrich Chemical Co.** has commenced expansion at Avon Lake, O., 22 miles west of Cleveland, where it has at present a general chemicals plant, experimental station, and currently under construction, an applied research laboratory. The new manufacturing facilities will produce Geon polyvinyl chloride resins. The vinyl plant will consist of two buildings: a three-story process building with 40,000 sq ft of floor space and a warehouse. Completion date is mid-1951.

♦

The "More Power to America Special", **General Electric Co.'s** mobile showcase of electric products for industry is on the second lap of its nationwide tour. The ten-car exhibit train will visit 29 key midwestern industrial centers this fall before swinging south, down the Atlantic coast. The exhibits aboard the train are designed specifically for the interest of those concerned with the generation and industrial application of electricity.

♦

Penn Metal Co. has let contracts for enlarging its plant at Parkersburg, W. Va. The additions amounting to 20,000 sq ft will be used for warehousing of raw materials and finished products and to accommodate increased manufacturing facilities for the present standard lines of Penmetal metal lath and expanded metal and new lines of metal lath accessories.

♦

V & O Press Division of Rockwell Mfg. Co. has been purchased by the **Hartford-Empire Co.** The Hudson, N. Y., plant will continue under present management.

♦

Coral Designs, division of **Henry G. Dietz Co.,** formerly located in Forest Hills, N. Y., is now operating in new expanded quarters located at 12-16 Astoria Blvd., Long Island City 2, N. Y. Facilities will be devoted to the standard line of electronic, electric and mechanical controls.

♦

The **Remington Arms Co. Inc.,** Bridgeport, Conn., and the **Crucible Steel Co. of America,** New York, N. Y., have formed a jointly owned company, **Rem-Cru Titanium Inc.,** which will produce titanium metal and titanium alloy products. Titanium ingots are currently being produced in the Remington plant. Ingots will continue to be produced at Bridgeport until new melting facilities now under construction

can be installed in Crucible's plants. A part of Rem-Cru's titanium processing is being done at Syracuse, N. Y., in Crucible's Sanderson-Halcomb Works where special facilities for rod, wire and other shapes and finishes are available. Billets, bars, plates and sheets are being produced at the Park Works in Pittsburgh, and other Crucible plants will be used as production requirements develop. At present, manufacturing and sales headquarters of Rem-Cru are in Bridgeport.

◆

E. I. du Pont de Nemours & Co. has taken an option on a tract of approximately 635 acres on the Neuse River between Kinston and Graingers, N. C., for the site of a new nylon yarn plant. This will be the fourth Du Pont plant engaged in nylon yarn and the ninth expansion of Du Pont nylon manufacturing facilities since World War II. Other plants at Seaford, Del., Chattanooga, Tenn., and Martinsville, Va., are presently undergoing expansions.

◆

Alexander Milburn Inc., manufacturer of oxyacetylene cutting and welding apparatus has moved to new headquarters at 1231-45 Ridgely St., Baltimore 30, Md.

◆

American Anode Inc., Akron, O., has purchased the **Wayne Knitting Mills** plant at Riverside, N. J. Present facilities will be increased to manufacture latex products; the plant will be in operation by June, 1951.

◆

The **Bjorsten Research Laboratories Inc.** has purchased a 168-acre tract on which will be erected buildings to house new testing units, scientific equipment and laboratories. Bjorksten industrial research work includes the fields of metals, petroleums, paper, graphic arts, plastics and coatings, engineering, organic synthesis, electrochemistry, biochemistry, and ceramics.

◆

Interests closely associated with **Oliver Iron and Steel Corp.,** Pittsburgh, Pa., have purchased management control stock of **Berry Motors Inc.,** Corinth, Miss., manufacturer of hydraulic transmissions and liquid transfer pumps. The new interests have provided additional working capital for the company to expand its commercial production.

◆

The **Warren Steam Pump Co. Inc.,** Warren, Pa., manufacturer of centrifugal pumps, has concluded negotiations for the purchase of the **Quimby Pump Division of H. K. Porter Co. Inc.,** Pittsburgh, Pa., manufacturer of screw and rotary pumps and various types of centrifugal pumps. The purchase includes inventory, patterns, goodwill, etc., and all manufacturing will be transferred to the Warren plant.

◆

Carlon Products Corp. is the new name of the Carter Products Corp., Cleveland, O., manufacturer of "Carlon" extruded plastic products.

ARCH SUPPORT
withstands the strains

because the "arch" is stronger

Extra strength to withstand electrical and mechanical strain . . . that's why Ward Leonard's STRIPOHM resistors are made with the broad sides *arched* instead of flat.

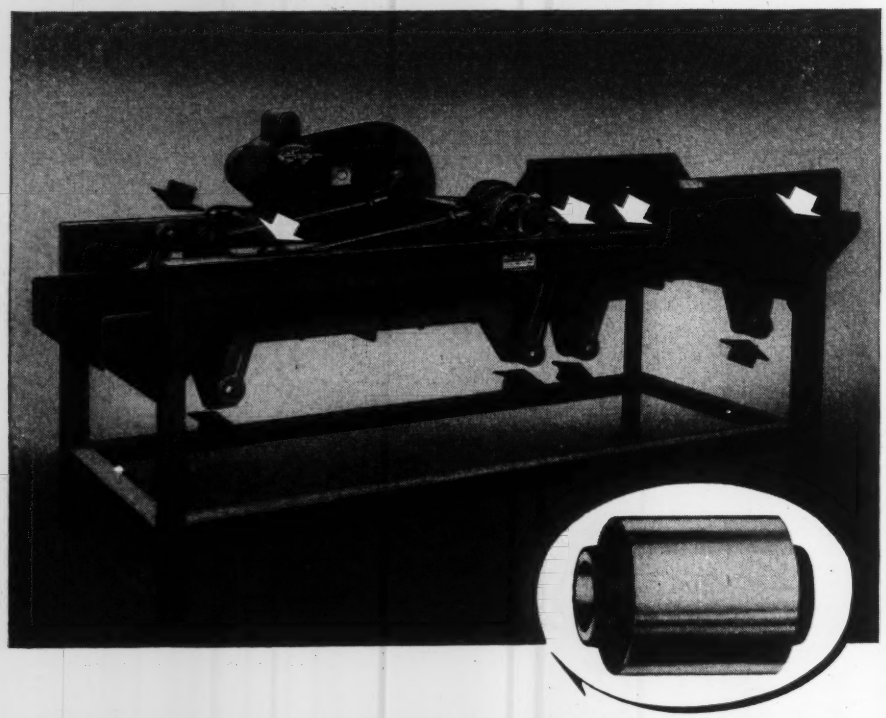
This hump-backed shape also gives you (1) more even and uniform winding because the wire *hugs* the core, (2) greater area for heat dissipation. Low mounting brackets and terminal arrangement facilitate multiple stacking.

Write for Bulletin 23. WARD LEONARD ELECTRIC COMPANY, 58 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

WARD LEONARD ELECTRIC COMPANY
Result-Engineered Controls
RESISTORS • RHEOSTATS • RELAYS • CONTROL DEVICES

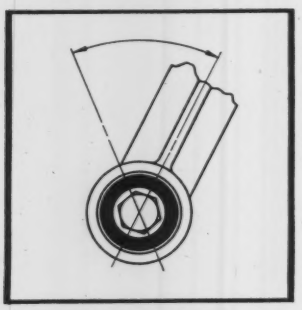
LORD BONDED RUBBER

Solves Shaker Table Bearing Problem



Shaker tables perform a wide variety of useful operations throughout industry. They remove soil and moisture from vegetables, shake mold sand from castings, grade gravel to size, and steadily feed products to machines and processes. Most operations involve the presence of grit and moisture—notorious enemies of bearing life. Hanger arm bearings developed noise, wore rapidly and failed early. The problem was to find bearings which would give satisfactory service life under such conditions.

Commercial Manufacturing & Supply Company, Fresno, Calif., solved the problem by using standard LORD Bonded Rubber Mountings. Torsional movement caused by reciprocating action of the shaker is accommodated by the flexibility of rubber. Installation is simple because mountings are small, compact units which are pressed and bolted in place. Since there are no frictional surfaces, moisture and abrasives have no effect. Longer bearing life, smoother operation and quieter performance resulted from the change to LORD Bonded Rubber.



BEARING ACTION

Many design problems which require accommodation of relative movement can be readily solved by LORD Bonded Rubber (rubber-bonded-to-metal) Mountings. Noise and vibration can be isolated to make better, more salable products. For information and assistance in selecting and applying LORD Bonded Rubber parts, write to attention of Product and Sales Engineering Dept.

LORD MANUFACTURING COMPANY · ERIE, PA.

Canadian Representative: Railway & Power Engineering Corp. Ltd.

LORD BONDED RUBBER

Vibration-Control Mountings . . . Bonded-Rubber Parts

SALES AND SERVICE PERSONNEL

RECENTLY ANNOUNCED was the appointment of **Alan J. Bronold** as sales manager for Sterling Electric Motors Inc., Los Angeles. Mr. Bronold will take over the duties of **Allen Adams,** who for a number of years has been in charge of the company's international and domestic sales organization. Because of illness Mr. Adams is relinquishing his duties of active sales management but will continue as an officer and secretary-treasurer of the company. Mr. Bronold was employed by the Vacuum Oil Co. prior to 1926. He has been associated with the Westinghouse Electric Corp. since that time, having served in a number of sales and executive capacities. In his new capacity as sales manager, Mr. Bronold will be responsible for development and expansion of sales for Sterling Speed-Trol, and Slo-Speed electric power drives, and Sterling Klosd and Klosd-Tite constant speed motors.

♦

M. W. Sledge has been named to replace the late **E. W. Stephen** as manager of the belt sales department at the Goodyear Tire & Rubber Co. Formerly assistant manager, Mr. Sledge will direct all belt sales activities and will work closely with **C. F. Smith,** newly appointed chief project engineer on large conveyor belt prospects. **H. R. Harrington** is now assistant manager of this department.

♦

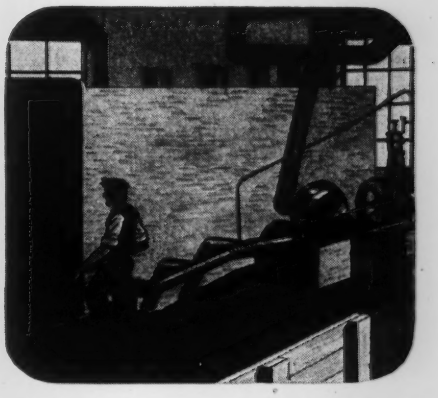
Affiliated with Ampco Metal Inc. for over nine years, for the past several years working out of the Milwaukee district office, **A. D. Jenss** has been appointed district manager of the Cincinnati office.

♦

Willard R. Barrett has been named sales manager for the plastics division of the General Electric Co. He has been with the Hoosier Cardinal Corp., vendor manufacturers of decoratives, metals and plastics, for the past three years and prior to that was associated with the E. I. du Pont Co. for 24 years. General Electric has also announced the appointment of **William E. Herrmann** to manager of sales of the company's special products department, as well as the appointment of **Dwight E. Moorhead** as manager and **Charles Stoeckly** as manager of the sales division of the

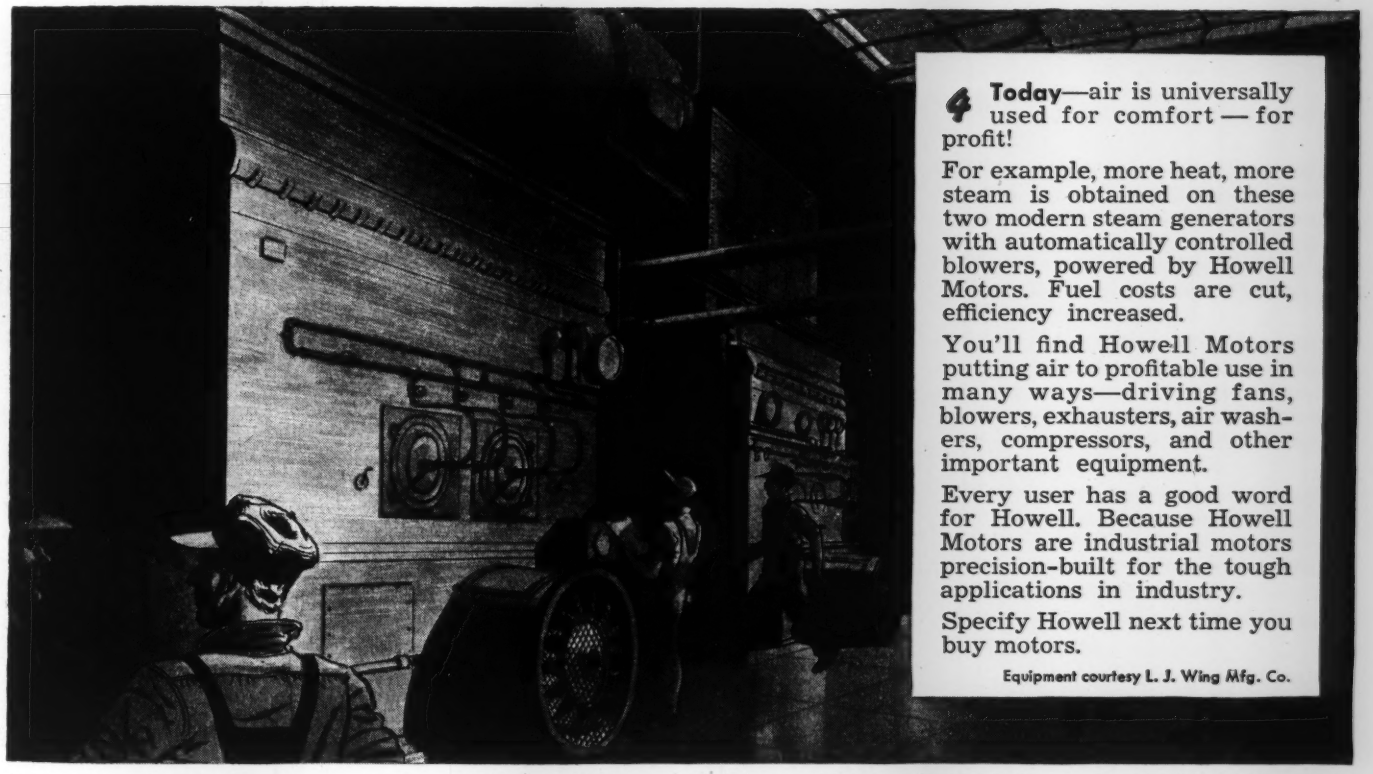
1 1561—A crude, manually operated bellows like this was used in an attempt to pump fresh air into a mine in Switzerland. And man's quest for comfort, by putting air to work, was under way.

2 1700—This age-old method of moving air for its cooling effect was used in many parts of the world. Needed was a form of low-cost power that would move air mechanically, automatically, and efficiently.



3 1873—This steam-operated, forced draft fan promoted efficient burning of fuel in boilers. By 1915, Howell Electric Motors arrived. The era of electrical power put the handling of air on a paying basis.

NOW... AIR IS PUT TO PROFITABLE USE!



4 **Today**—air is universally used for comfort — for profit!

For example, more heat, more steam is obtained on these two modern steam generators with automatically controlled blowers, powered by Howell Motors. Fuel costs are cut, efficiency increased.

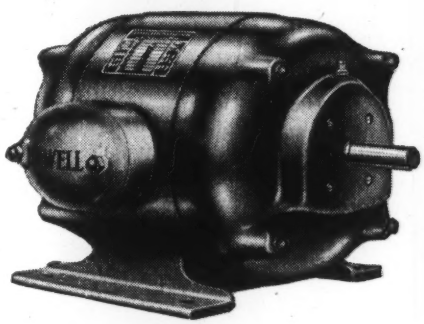
You'll find Howell Motors putting air to profitable use in many ways—driving fans, blowers, exhausters, air washers, compressors, and other important equipment.

Every user has a good word for Howell. Because Howell Motors are industrial motors precision-built for the tough applications in industry.

Specify Howell next time you buy motors.

Equipment courtesy L. J. Wing Mfg. Co.

Free enterprise encourages mass production, supplies more jobs—provides more goods for more people at less cost.



Howell Protected-Type Motor

HOWELL MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.

Precision-built Industrial Motors Since 1915

HOWELL Red Band MOTORS

Want Quality Copies in Quantity?

You'll get them with a Bruning Whiteprinter

The Bruning Whiteprinter produces quality copies — crisp, easy-to-read positive prints—in any quantity you desire. Get hundreds, if you want — with the last copy as clean and sharp as the first.

A Bruning Whiteprinter is the cleanest, fastest, most economical way to copy your drawings, records and reports. It handles any size up to 42" wide by any length. It makes black-on-white copies, or prints in any of 20 color combinations.

NEEDS NO PLUMBING OR EXHAUST DUCTS

To operate the Bruning Whiteprinter, just place the material* to be copied on a sheet of Whiteprint paper and insert both into the machine. Within seconds you have your copy — errorproof, smudge-proof, completely developed. Prints come out flat, dry and neatly stacked.

You have no installation troubles, either, with your Bruning Whiteprinter. You need only connect it to your electric supply, and it is ready to operate. It requires no plumbing; it needs no exhaust ducts.

Get top-quality copies in the quantity you want. Get them inexpensively and *on time*. Get a Bruning Whiteprinter! For full details, send coupon or write *Charles Bruning Company, Inc., Dept. E-100, 100 Reade St., New York.*

BRUNING
PERFECT PRINTS... WITHIN SECONDS... FOR PENNIES
WHITEPRINTERS

**If your original is opaque, the Bruning Whiteprinter quickly copies it into translucent stock from which you make as many Whiteprints as you want.*

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Dept. E-100, 100 Reade St., New York, N. Y. Offices in principal cities
Please send me free Booklet A-1056 describing the Bruning Whiteprint Process.
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Company_____ Position_____
Address_____
City_____ Zone____ State_____

San Jose (Calif.) motor divisions of the small and medium motor divisions. Also, **John R. Casey** has been appointed manager of the newly established gas turbine sales division of the General Electric apparatus department's turbine divisions, with headquarters in Schenectady.

♦

Recently announced was the appointment of **Richard H. Frizzell** as sales manager of the structural products department of the Wickwire Spencer Steel Division of the Colorado Fuel and Iron Corp. Mr. Frizzell replaces **G. L. Crawford,** who will devote his full time to the position of sales manager of the division's Buffalo sales district. Both men will continue to make their headquarters at the division's offices in the Wickwire Bldg., 361 Delaware Ave., Buffalo, N. Y.

♦

D. C. Miner, advertising manager of E. F. Houghton & Co., Philadelphia, has been named a director of the company.

♦

Appointment of **Nils Walter Swenson** as assistant manager of branch sales for the mechanical goods division, United States Rubber Co., was announced recently. Former manager of mechanical goods sales for the Buffalo branch, Mr. Swenson will make his new headquarters at the company's New York offices in Rockefeller Center.

♦

Lee O. Witzenburg has been named general sales manager for Cleveland Worm & Gear Co., Cleveland, and its subsidiary, the Farval Corp. He formerly served as sales manager for the V-belt division of Gates Rubber Co. and sales manager of the Tann Corp. of Detroit.

♦

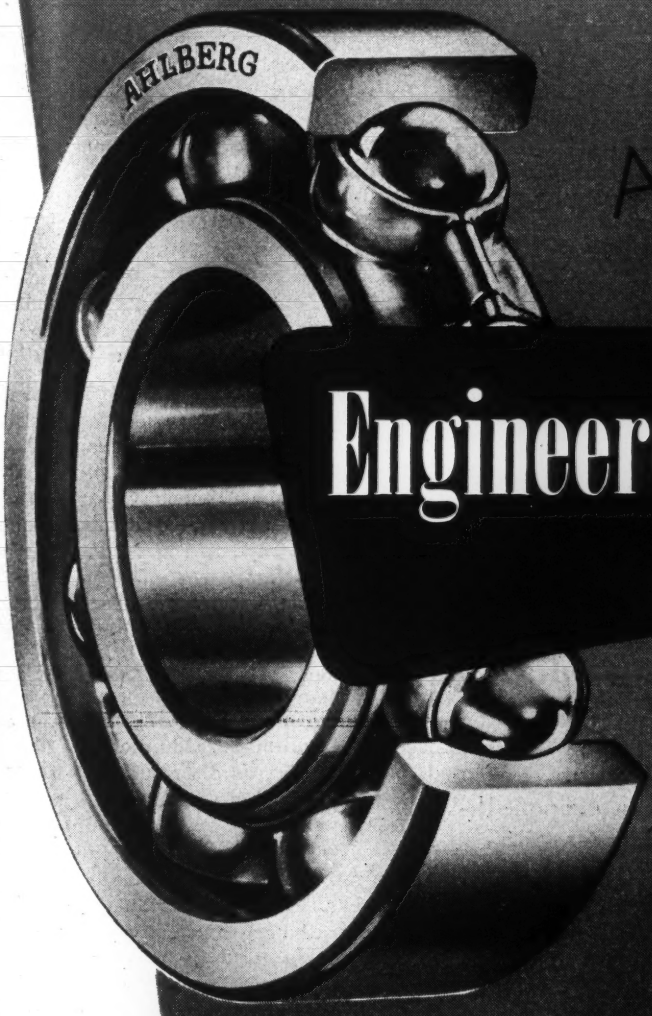
Associated with the company for over seven years, serving as sales representative in Indiana, Ohio, Pennsylvania and New York, **Glenn F. Ihrig** has been named assistant sales manager of the Wellman Bronze & Aluminum Co. of Cleveland.

♦

Appointment of **Roger S. Ahlbrandt** to the newly created position of manager of stainless steel bar sales of Allegheny Ludlum Steel Corp. has been announced. Mr. Ahlbrandt had been assistant manager, cutting tool sales, and is replaced in that position by **I. R. Leheny,** who, in turn, is succeeded as sales manager of the San Francisco district office by **Guy M. Winton.**

AHLBERG

PRECISION ANTI-FRICTION PRODUCTS



Engineered *for Super Service*

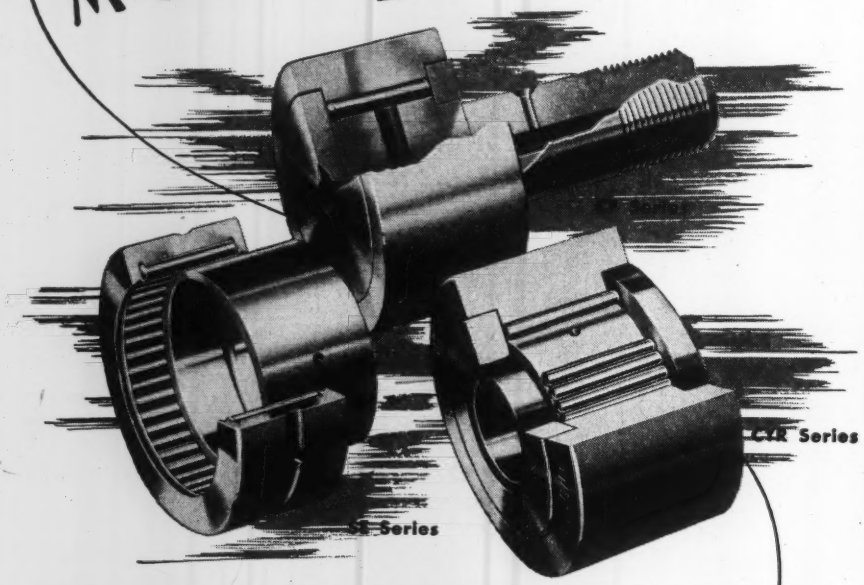
It's well to remember, when you're thinking of power transmission and operating costs, that only smooth power is truly efficient; truly economical power. And smooth power can only come from machines properly and adequately equipped with bearings specifically engineered to deliver super service . . . for example AHLBERG bearings. Try, test and compare Ahlberg bearings. We believe you'll decide your dollars can't buy better performance than these fine bearings give. Reasons? Well, if you were to micro-analyze any Ahlberg ball bearing you would find . . . balls that are accurate to .000025" in sphericity, matched in sets to .000025" . . . "generated" raceways that assure true race curvature . . . chrome alloy electric furnace steel that is meticulously heat-treated for maximum toughness without brittleness. In all other ways from blue print inception to final inspection, Ahlberg bearings are . . . precision made—with precision mated components. Complete engineering assistance and quotations without obligation.

AHLBERG BEARING COMPANY
3035 West 47th Street, Chicago 32, Illinois
Precision Craftsmen Since 1908

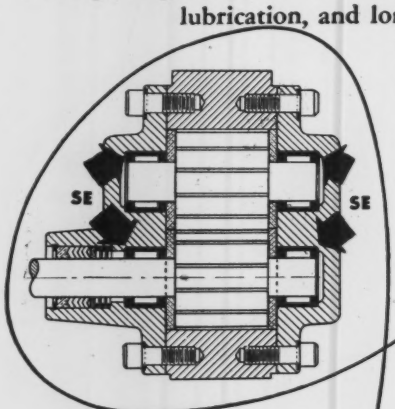
AHLBERG BALL BEARINGS • ROLLER BEARINGS • THRUST BEARINGS AND BALL BEARING HOUSINGS

DISTRIBUTORS IN ALL PRINCIPAL INDUSTRIAL AREAS

Costs less in the long run
McGILL® MULTIROL® Bearings

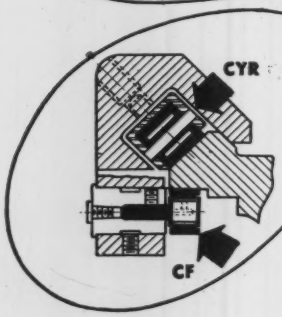


The bonus values found in McGill Multirol roller bearings are worth money to you. They mean increased profit measured in terms of savings . . . through improved anti-friction performance. This better performance is due to the consistently higher degree of precision . . . that marks all McGill bearings. For smooth performance, low starting torque, minimum maintenance, ease of assembly, simplified lubrication, and long life in your roller bearing applications . . . investigate the McGill SE, CF and CYR Multirol bearings.



SE Series in Gear Pump Application

Gear pump using MULTIROL SE Series Bearings replacing plain bearings on both drive and idler shafts for greater precision and longer life. Capacity is increased while radial bearing space is held to minimum of throat requirements.



CF and CYR Series in Slide and Carriage Application

MULTIROL Cam Followers and Cam Yoke Roller Bearings permits precision movement of Cross Slide and Carriage — eliminates costly machining and scraping of gibbs and ways. Simplifies assembly and lubrication. Also ideally suited to tail stocks.

For informative literature write: McGill Manufacturing Co., Inc., Bearing Division, 200 N. Lafayette St., Valparaiso, Indiana.

McGILL® precision bearings

SALES NOTES

PLANS for the construction of two adjoining buildings for warehouse and sales office space in Atlanta have been announced by the **Minnesota Mining & Manufacturing Co.** of St. Paul. To be ready for occupancy the first of next year, the one-story structures will have a total floor area of 12,500 square feet and will be located on Piedmont Rd. north of Metal Rd. in Atlanta.

♦

Clifford B. Ives & Co., 105 Forrest Ave., Narberth, Pa., has been appointed representative for **Chiksan Co.** of Brea, Calif., in the Philadelphia territory, and the Rhodes Controls Co., 11 East 21st St., Baltimore, Md., has been named to represent Chiksan in the Baltimore area. Both of these territories were covered previously by Chiksan's eastern headquarters in Newark, N. J.

♦

Appointment of **C. E. Thurston & Sons Inc.,** 30-32 Commercial Place, Norfolk, Va., as distributor of **Hewitt Rubber Division** products in the Norfolk area has been announced by **Hewitt-Robins Inc.** of New York. Thurston & Sons will handle the division's line of materials including industrial hose and conveyor belting.

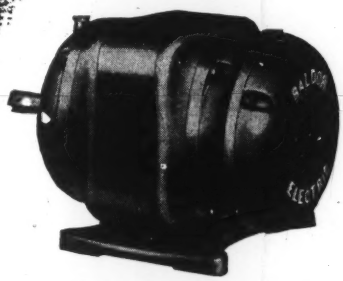
♦

The **Superior Electric Co.** of Bristol, Conn., has opened a new office to serve the Ohio and western Pennsylvania areas. This office, located in Room 1118, Fidelity Bldg., 1940 East Sixth St., Cleveland, O., will be headed by Harold W. Lorenson.

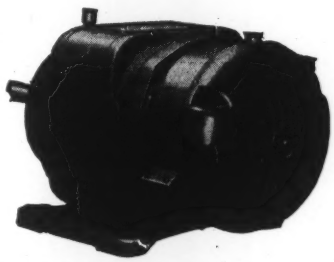
♦

A subsidiary of **Eaton Manufacturing Co.** and prominent manufacturer of adjustable-speed couplings, dynamometers, etc., **Dynamatic Corp.** of Kenosha, Wis., has appointed **Wiard and Gregg** as sales representative in the area covering eastern New York, northern New Jersey and western Connecticut. The new sales organization has been formed by two men with considerable experience in the application of Dynamatic devices. Robert C. Wiard, as former research engineer for New Britain Gridley Machine Co., is thoroughly familiar with a wide variety of applications of Dynamatic adjustable-speed couplings,

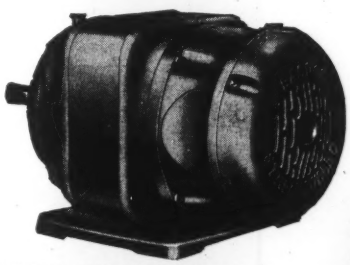
These BALDOR Streamcooled Motors can't inhale Dust, Dirt or Lint



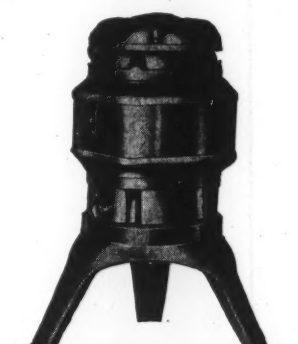
BALDOR STREAMCOOLED Polyphase Motor, 1 to 20 HP.



BALDOR STREAMCOOLED Direct Current Motor, 1 to 5 HP.



BALDOR STREAMCOOLED Single Phase Motor, ¾ to 7½ HP.



BALDOR STREAMCOOLED Face-mounted Vertical Motor, Single Phase, 3 Phase, and Direct Current.

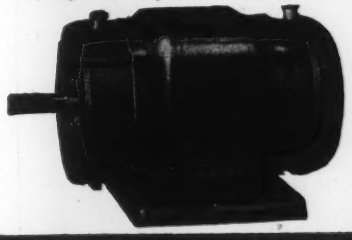
BALDOR STREAMCOOLED MOTORS **are *totally enclosed*, yet are constantly and efficiently cooled by a guarded outer-mounted fan forcing air over the entire exterior of the motor frame . . . as indicated by arrows in the above picture. This additional protection is an outstanding feature of all Baldor motors.**

Dust, dirt, lint, etc., cannot reach the inner mechanism of the motor to CLOG UP and reduce the operating efficiency of the motor. These motors, therefore, require LESS FREQUENT CLEANING . . . LESS SERVICING.

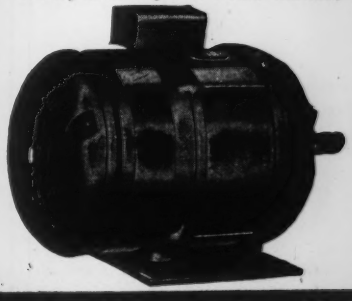
Baldor BETTER MOTORS

For More Than a Quarter of a Century

BALDOR STREAM-COOLED Face-mounted Motor, Single Phase, 3 Phase, and Direct Current.



BALDOR STREAMCOOLED Round Frame Motor, ⅓ to ¾ HP., Single Phase, 3 Phase, and Direct Current.

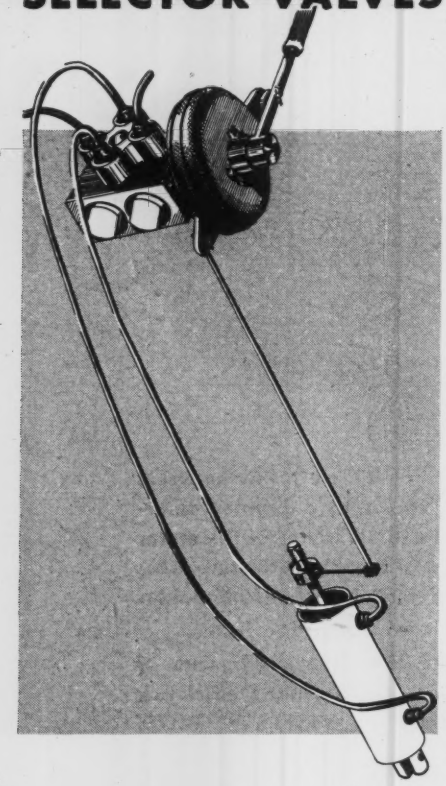


GENERAL OFFICES AND FACTORY, ST. LOUIS 10, MO.

Provide the MISSING LINK for Remote Controls with

Electrol

FOLLOW-UP SELECTOR VALVES



Solved, at last, is the problem of providing *the missing link* for remote controls. The Electrol Follow-up Selector Valve, actuated by a finger-tip control handle, located at a central station — and used with a hydraulic cylinder — provides the ultimate in accurate remote positioning. Write for details, or — if you prefer — advise when it would be convenient for one of our engineers to call at your plant.

Better Designed Products Use Electrol Hydraulics

Electrol

89 GRAND STREET INCORPORATED
KINGSTON, NEW YORK

CYLINDERS · SELECTOR VALVES · FOLLOW-UP VALVES
CHECK VALVES · RELIEF VALVES · HAND PUMPS
POWERPAKS · LANDING GEAR OLEOS · SOLENOID
VALVES · ON-OFF VALVES · SERVO CYLINDERS · TRANSFER
VALVES · CUT-OUT VALVES · SPEED CONTROL VALVES

FOR BETTER HYDRAULIC DEVICES

and Walter E. Gregg, sales representative for Dynamatic products in the Cincinnati territory for many years, has had extensive experience in engineering all types of Dynamatic installations. Headquarters for Wiard and Gregg have been established at 101 South Main St., Middletown, Conn.

♦

In response to the marked growth of metal-working industries throughout the South, and to increased demand for diversification of its own products, the **Atlantic Steel Co.**, Atlanta, announced recently the formation of a product engineering department. One of the main objectives of the new department is to provide direct services to Atlantic Steel customers, as well as to other metal consumers and fabricators in the form of free consulting-type assistance in such areas as product design, plant layout, fabrication problems, metallurgical problems, market surveys and analysis and other similar manufacturing and marketing problems.

♦

Manufacturer of magnetos and ignition systems for the aircraft, automotive and marine industries, the **Scintilla-Magneto** division of **Bendix Aviation Corp.**, Sidney, N. Y., has announced a realignment of its Midwest sales area. The north Midwest territory—including Wisconsin, Illinois, Iowa, Minnesota, Nebraska, South Dakota, North Dakota, Missouri, Arkansas, Louisiana, Colorado, Wyoming and Montana—will be under the supervision of W. G. (Gray) Roloson, former sales engineer in the company's Detroit office. The states of Kansas, Oklahoma and Texas make up the south Midwest territory, under the direction of M. E. Douglass. Mr. Douglass formerly handled all sixteen states and, like Mr. Roloson, will now make his headquarters in Milwaukee.

♦

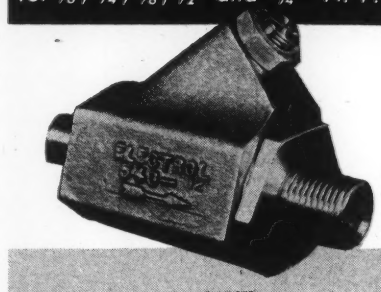
To serve metropolitan New York, eastern and New England state regions, the **Kenilworth Steel Co.** has opened its modern new plant at 750 Boulevard in Kenilworth, N. J. The company has facilities for slitting and cutting to length of customer's material. Products to be stocked initially are entirely in the flat rolled metal category in gages 0.001 to 0.187, including Thinsteel and Thinsteel stainless strip, made by the Cold Metal Products Co.; Republic Enduro stainless sheets and coils; high and low carbon cold rolled strip; electro galvanized coils; and aluminum coils and flat sheets.

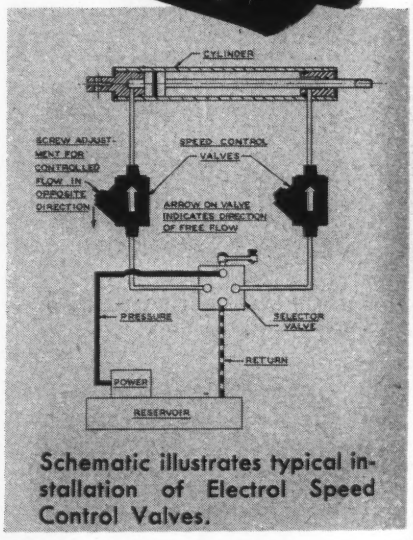
Ready for IMMEDIATE DELIVERY!

Electrol

SPEED CONTROL VALVES

for 1/8, 1/4, 3/8, 1/2 and 3/4" N. P. T.





Schematic illustrates typical installation of Electrol Speed Control Valves.

Electrol Speed Control Valves are designed for use in air or oil, with operating pressures up to 1,500 p.s.i. They allow flow in one direction and, by use of a metering device and check valve, accurately control reverse flow from 0 to valve maximum — even after thousands of cycles. Send us your print so we can work with you in adapting this unit to meet your specific requirement.

Better Designed Products Use Electrol Hydraulics

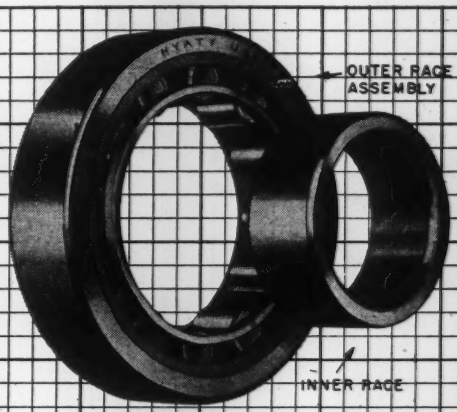
Electrol

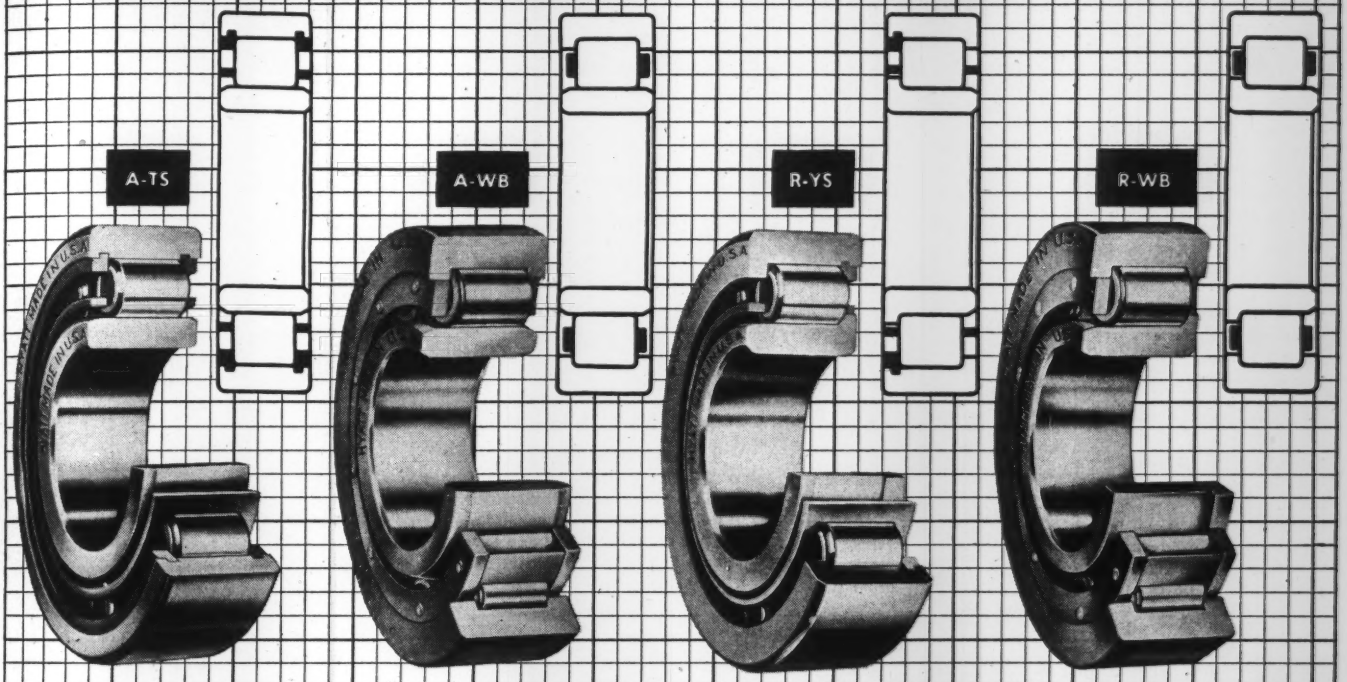
89 GRAND STREET INCORPORATED
KINGSTON, NEW YORK

CYLINDERS · SELECTOR VALVES · FOLLOW-UP VALVES
CHECK VALVES · RELIEF VALVES · HAND PUMPS
POWERPAKS · LANDING GEAR OLEOS · SOLENOID
VALVES · ON-OFF VALVES · SERVO CYLINDERS · TRANSFER
VALVES · CUT-OUT VALVES · SPEED CONTROL VALVES

FOR BETTER HYDRAULIC DEVICES

For Separable Inner Race Bearings-- HYATT HY-LOADS





IN the Hyatt Hy-Load line of solid cylindrical roller bearings there are four types which are made with separable inner races. These inner races are freely interchangeable with any roller assembly of the same number thus permitting non-selective fitting after pre-assembling the two bearing parts in separable machine elements. This Hyatt feature speeds final assembly, permits more efficient production planning and layout, and often leads to improvements in product design.

When a shaft of larger diameter is needed for greater rigidity or a bearing of smaller size is desired, the separable inner race can be omitted and the rollers operated directly on the shaft in instances where the bearing operating surface of the shaft can be of suitable hardness and finish.

In addition to the Hy-Loads with separable inner races there are separable outer race and non-separable types each of which are made in a wide range of sizes.

Full information about all Hyatt Hy-Load Roller Bearings is contained in Catalog 547 . . . a complete engineering guide to radial bearing selection and use. Write for your copy today. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

HANNIFIN *Superior!*

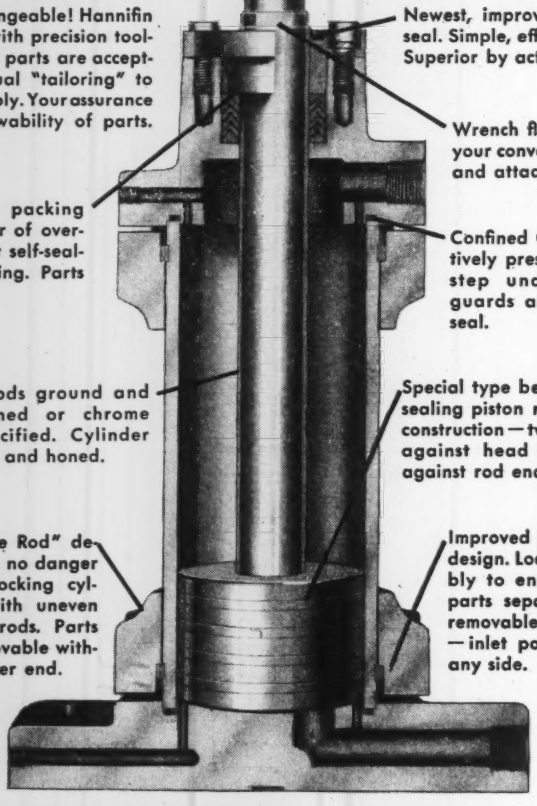
DESIGN and CONSTRUCTION

All parts interchangeable! Hannifin builds cylinders with precision tooling. Only perfect parts are acceptable; no individual "tailoring" to suit factory assembly. Your assurance of life-long renewability of parts.

Positive-seating packing gland — no danger of overtightening against self-sealing chevron packing. Parts readily accessible.

Finest finishes. Rods ground and polished, hardened or chrome plated when specified. Cylinder walls "Tru-Bored" and honed.

Hannifin's "No Tie Rod" design. No nuisance, no danger of stressing or cocking cylinder assembly with uneven tightening of tie rods. Parts at either end removable without disturbing other end.



Newest, improved type dirt wiper seal. Simple, effective, long lasting. Superior by actual test.

Wrench flats on rod end for your convenience in installing and attaching.

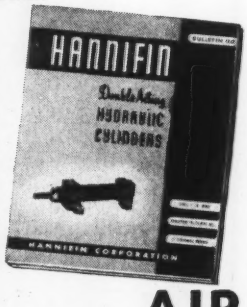
Confined O-ring seals — positively pressure sealing. Note step under cylinder end guards against crushing of seal.

Special type beveled-step, pressure sealing piston rings. Full four ring construction — two positioned to seal against head end pressure, two against rod end pressure.

Improved split retaining ring design. Locks cap-collar assembly to end of cylinder. All parts separable and readily removable. Universal end caps — inlet ports can placed on any side.

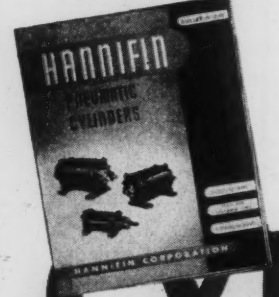
EXAMPLE: Hannifin Model HN Hydraulic Cylinder — flange mounting, head end.

HYDRAULIC . . . . . .



You can save time and money right from the start by checking with Hannifin on all of your *hydraulic cylinder* requirements: 12 standard bore diameters, 1" to 8". . . any length stroke you specify . . . 11 standard mounting styles . . . standard, double end or heavy duty (2:1) piston rods . . . available with adjustable cushions . . . standard pressures to 1500 lbs. per sq. in. Special designs to order. Get your copy of Bulletin No. 110.

. . . . . AIR



It's easy to get the right answer for even the most special jobs when you use Hannifin's book on PNEUMATIC CYLINDERS. 48 pages of helpful specification and engineering data, complete with diagrams and dimensions. Ask for Bulletin No. 210. HANNIFIN CORPORATION, 1115 S. Kilbourn Avenue, Chicago 24, Illinois.

CYLINDERS

MEETINGS AND EXPOSITIONS

Oct. 16-18—

Society of Automotive Engineers. Transportation meeting to be held at the Statler Hotel, New York, N. Y. John A. C. Warner, 29 West 39th St., New York 18, N. Y., is secretary and general manager.

Oct. 16-20—

National Safety Council. The thirty-eighth congress and exposition of the National Safety Council will be held at the Stevens, Congress and Morrison Hotels. Additional information may be obtained from R. L. Forney, General Secretary, 425 N. Michigan Ave., Chicago 11, Ill.

Oct. 18-19—

National Conference on Industrial Hydraulics. Sixth annual meeting to be held at the Sherman Hotel, Chicago, Ill., under the sponsorship of the Illinois Institute of Technology and local sections of ASCE, ASME, SAE, Western Society of Engineers, ASLE, ALChE and IAS. Frank W. Edwards, Illinois Institute of Technology, 3300 South Federal St., Chicago 16, Ill., is conference secretary.

Oct. 18-20—

Society of the Plastics Industry. Annual national conference to be held at New Ocean House, Swampscott, Mass. William T. Cruse, 295 Madison Ave., New York 17, N. Y., is executive vice president.

Oct. 23-25—

American Gear Manufacturers Association. Semi-annual meeting to be held at the Edgewater Beach Hotel, Chicago, Ill., Newbold C. Goin, Empire Bldg., Pittsburgh, Pa., is executive secretary.

Oct. 23-27—

American Institute of Electrical Engineers. Fall meeting to be held at the Skirvin Hotel, Oklahoma City, Oklahoma. H. H. Henline, 33 West 39th St., New York 18, N. Y., is secretary.

Oct. 23-27—

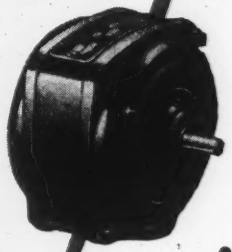
National Metal Congress and Exposition. The 32nd annual metal congress and exposition to be held at the Chicago International Amphitheatre, Chicago, Ill. W. H. Eisenman, 7301

Measuring Split Seconds . . .

with the help of Holtzer-Cabot motors!

This ingenious electronic device, made by American Time Products, Inc., tells in 30 seconds exactly how fast or how slow any watch is running per 24 hours (a job that used to require weeks of checking). Here's how it works: — the ticks of a watch, picked up by a sensitive crystal microphone, activate a stylus which prints a dot for each tick on a revolving chart drum. The pattern made by these dots indicates the slightest variation of time-keeping accuracy, and also indicates the cause of any irregularity.

Designing a suitable motor for this high-precision instrument presented a difficult problem, due to the demanding specifications of the application:



- The motor must rotate the drum with an accuracy of one part in one hundred thousand.
- The motor must be exactly synchronous.
- It must have the necessary torques to operate the mechanical system with a margin of safety.
- The velocity of rotation must be perfectly smooth and uniform.
- The motor must be free from all electrical and mechanical noises which might be picked up by the microphone.

Holtzer-Cabot engineers were called in at the prototype stage and, working with American Time Products' engineers, met all requirements by designing a modification of the Holtzer-Cabot RWC 2505 synchronous motor. Result — years of trouble-free performance in the field.

This is just another example of Holtzer-Cabot's ability to meet the most demanding specifications in small-motor applications. Holtzer-Cabot motors range from 1/2000 up through 1½ H.P.; from 24,000 RPM to 1 revolution per day!

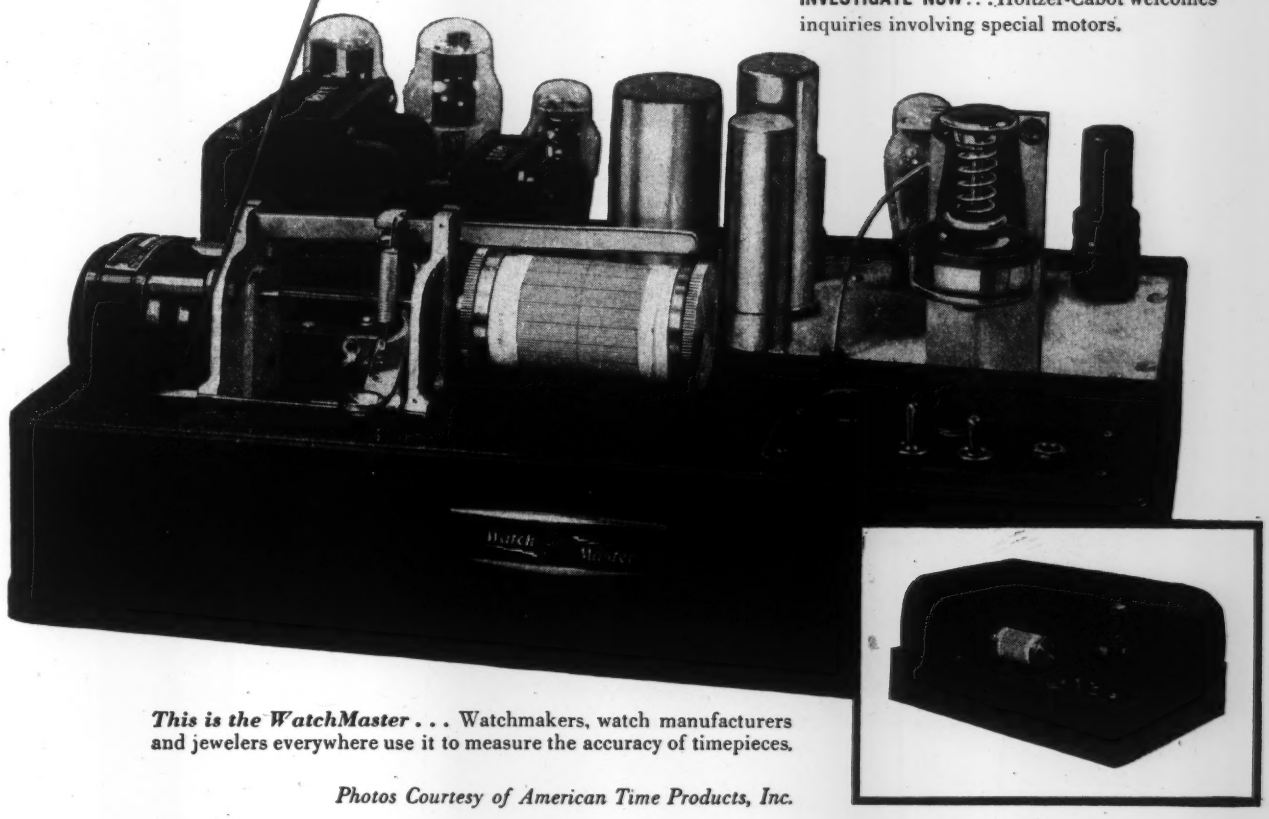
HOLTZER-CABOT

DIVISION OF NATIONAL PNEUMATIC CO., INC.

BOSTON 19, MASSACHUSETTS

"builders of fine electric motors for three quarters of a century"

INVESTIGATE NOW. . . Holtzer-Cabot welcomes inquiries involving special motors.



This is the WatchMaster . . . Watchmakers, watch manufacturers and jewelers everywhere use it to measure the accuracy of timepieces.

Photos Courtesy of American Time Products, Inc.

Titeflex

The ALL-METAL Flexible Tubing

Solves all these Problems

for you:

VIBRATION
EXPANSION
CONTRACTION
MISALIGNMENT
FLEXING
PRESSURE
VACUUM
TEMPERATURE
CORROSION

If you use tubing to convey liquids, gases or semi-solids, Titeflex can help you do it better, at less cost. Titeflex flexible tubing is made in brass, bronze, stainless, monel and inconel, to fill most heat, pressure and corrosion requirements. It's made in a full range of sizes, complete with any required types of fittings. In addition, Titeflex is *all-metal,* does not depend on packed sliding joints for its flexibility. That's why it is more resistant to fatigue . . . why it *lasts longer.*

Write us for catalog outlining Titeflex advantages in full.

Titeflex, Inc.

500 Frelinghuysen Ave., Newark 5, N. J.

TITEFLEX ALL-METAL FLEXIBLE TUBING STAYS TIGHT WHEN THE GOING IS TOUGH.

Euclid Ave., Cleveland, Ohio, is managing director of the exposition.

Oct. 23-27—

American Society for Metals. Annual meeting to be held at the Palmer House, Chicago, Ill. W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio, is secretary.

Oct. 23-27—

American Welding Society. Annual meeting to be held at the Sherman Hotel, Chicago, Ill. J. G. Magrath, 33 West 39th St., New York 18, N. Y., is national secretary.

Oct. 23-27—

American Institute of Mining and Metallurgical Engineers. Fall meeting of the Metals Branch to be held at the Sheraton Hotel, Chicago, Ill. E. H. Robie, 29 West 39th St., New York 18, N. Y., is national secretary.

Oct. 23-27—

Society for Non-Destructive Testing. Annual meeting to be held at the Hotel Morrison, Chicago, Ill. Phillip D. Johnson, Skokie, Ill. is national secretary.

Nov. 1-3—

American Society of Body Engineers. Fifth annual technical convention to be held at the Rackham Memorial Bldg., Detroit, Mich. Additional information may be obtained from Society headquarters, 100 Farnsworth, Detroit 2, Mich.

Nov. 2-3—

Industrial Management Society. Fourteenth annual time, motion and management clinic to be held at the Sheraton Hotel, Chicago, Ill., under the sponsorship of the Research Division. Additional information may be obtained from Society headquarters, 35 E. Wacker Drive, Chicago 1, Ill.

Nov. 2-3—

Metals Casting Conference. Third annual conference to be held on the Purdue University campus, Lafayette, Ind., under the sponsorship of Purdue University in cooperation with American Foundrymen's Society. Additional information may be obtained from L. L. Andrus, American Wheelabrator and Equipment Corp., Mishawaka, Ind.

Nov. 2-3—

Society of Automotive Engineers. Diesel engine meeting to be held at the Knickerbocker Hotel, Chicago, Ill. John A. C. Warner, 29 West 39th St., New York 18, N. Y., is secretary and general manager.

"Commercial" Ball-Bearing Data...#9 of a Series

WE WILL BE GLAD TO SEND YOU COPIES OF THE PREVIOUS ADVERTISEMENTS IN THIS SERIES.

How Schatz "Commercial" Ball Bearings can cut Anti-Friction Costs 35 to 85%

These tables show how Schatz "Commercial" Ball Bearings can deliver required anti-friction performance at ⅔ to ⅙ the cost of expensive precision bearings.

Take, for example, an application in which the radial load is 290 lb., the thrust load is 40 lb., and shaft speed is 150 rpm.

Equivalent radial load is 330 lb. (290+40).

From the speed-load curve in Fig. 1, the correction factor at 150 rpm is 1.65. Dividing 330 lb. by 1.65 gives 200 lb.—the loading at 600 rpm.

Fig. 2 shows two bearings which will support this load. One has 13 balls, 5/16" in diameter, and the other has 20 balls of ¼" diameter.

Fig. 3 gives minimum O.D. and maximum bore for these two bearings. For that of thirteen 5/16" balls, O.D. is 2", bore is 13/16". For that of twenty ¼" balls, O.D. is 2¼", bore is 1¼".

If Ground "Commercials" are used, the load-carrying capacity is increased 2.17 times. To use the tables, it is necessary only to divide the computed equivalent radial load by 2.17.

If thrust load is greater than radial load, a radial-thrust or straight thrust bearing should be used.

It will pay you to investigate the savings possible with "Commercials" where operating conditions are within the load and speed limits of these versatile low-cost ball bearings. Or if your application requires it, our engineers can adapt or design a special Schatz Ball Bearing to fit your specific job requirements—often at less cost than a standard precision bearing.

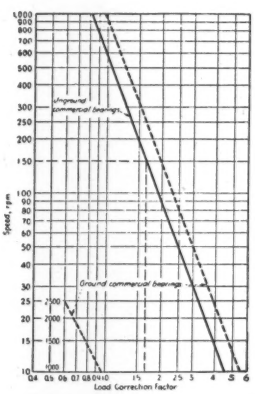


Fig. 1. Speed-load correction factors for "Commercials." This is necessary since bearing life is rated at 600 rpm.

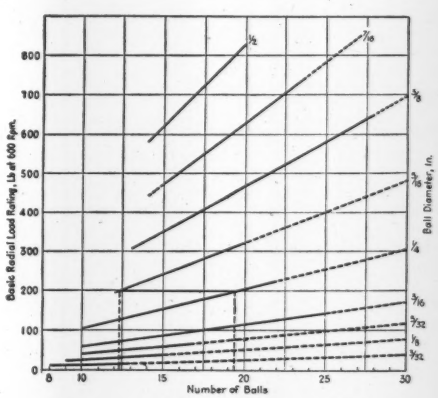


Fig. 2. Load rating at 600 rpm of ball complements used in Unground "Commercials."

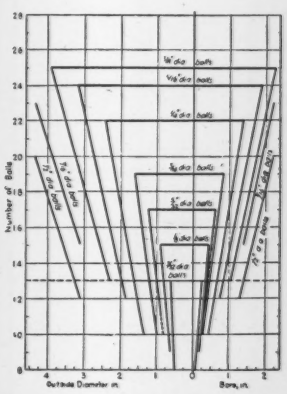
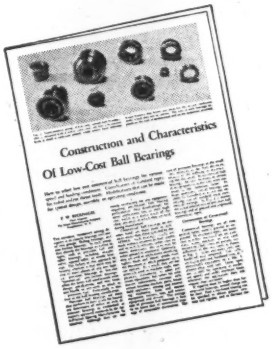


Fig. 3. Approximate maximum bore and minimum O.D. of Unground "Commercials."



THESE AND OTHER TABLES showing correct size and type "Commercial" Ball Bearings for various speed and loading conditions, and graphs for estimating bearing life, are included in "Construction and Characteristics of Low-Cost Ball Bearings." This technical booklet also discusses modifications that can be made for special design, assembly and operating conditions. Catalog No. 11 gives data on the complete Schatz "Commercial" line. Write for your copies today.

SCHATZ
"Commercial"
BALL BEARINGS

The Schatz Manufacturing Company
6760 FAIRVIEW AVENUE, POUGHKEEPSIE, N. Y.

You're ahead of the parade with ..ALLEN ⬡ HEAD SCREWS

New manufacturing methods and improved alloys are constantly bettering the quality and uniformity of socket screws, dowel pins and pipe plugs.

Not all the improvements are made first by Allen but a *very large percentage of them are.* Some of the most important have yet to be duplicated even after years of trying.

IF YOU BUY SOCKET SCREWS, DOWEL PINS OR PIPE PLUGS . . .

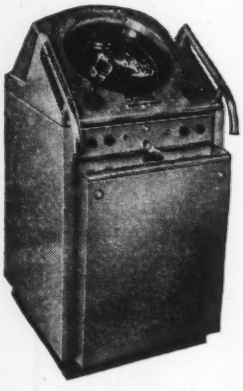
standardize on genuine Allen products to get more important improvements sooner.

IF YOU ARE DESIGNING OR IMPROVING A PRODUCT . . .

check with Allen directly or through your industrial distributor. Frequently a long search for more satisfactory fastenings ends in the Allen engineering department.

SOLD ONLY THROUGH LEADING DISTRIBUTORS

Write the factory direct for technical information and descriptive literature.



ASK RAYTHEON:

Allen ⬡ Head screws are required to meet the standards of most of the Raytheon products manufactured on Government contracts; hence they are used widely on the equipment made by this prominent manufacturer.

ALLEN ALLEN HEAD
MANUFACTURING COMPANY
Hartford 2, Connecticut, U. S. A.
NEW YORK, CLEVELAND, DETROIT, CHICAGO, LOS ANGELES

DESIGN ABSTRACTS

Recent discussions on new materials and applications

Titanium and Zirconium Fabrication

IN ORDER to fabricate titanium and zirconium intelligently, it is necessary to have a clear understanding of the great importance of small amounts of impurities, which are easily picked up by these reactive metals during their primary production.

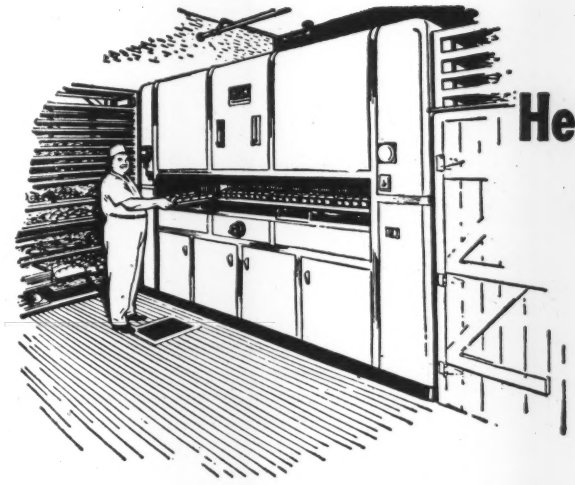
The purest and most ductile titanium or zirconium is obtained by the iodide method. Such metal can absorb tremendous amounts of cold work without fracture, provided only that the work is introduced in steps rather than all at once. For example, by a large number of rerolling steps, very pure iodide zirconium has been reduced from a bar 5/16-in. in diameter to strip as thin as 0.005-in. without annealing, and the strip retained considerable ductility.

The metal in widest commercial use is produced as "sponge" by magnesium reduction of titanium or zirconium tetrachloride, a process less costly than the iodide method. After the sponge metal has been remelted in graphite, it contains from 0.5 to 1 per cent carbon but is relatively low in nitrogen and oxygen. Titanium and zirconium that have been melted in a water-cooled copper mold are the most workable of the commercial products from sponge, but naturally are of lower strength than when produced by a method that introduces carbon, nitrogen and oxygen.

Very Sensitive To Other Elements

A few hundredths or a few tenths of a per cent of nitrogen or oxygen alters the properties of both titanium and zirconium about as drastically as steel is altered by carbon up to the eutectoid composition. Below about 0.25 per cent increasing carbon content has a marked strengthening effect on titanium; the accompanying loss in ductility is appreciable but not prohibitive. Above about 0.25 per cent, carbon adds little to strength and considerably reduces workability.

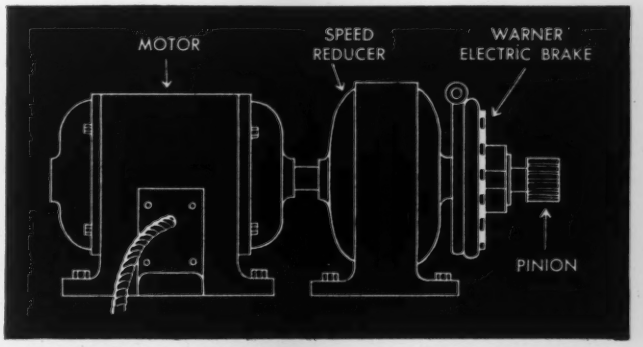
When compared with magnesium, both titanium and zirconium exhibit



Here's how smart designers are solving their problems of clutching, braking, automatic control, shock and torque by using WARNER ICB UNITS

IF YOUR PROBLEM

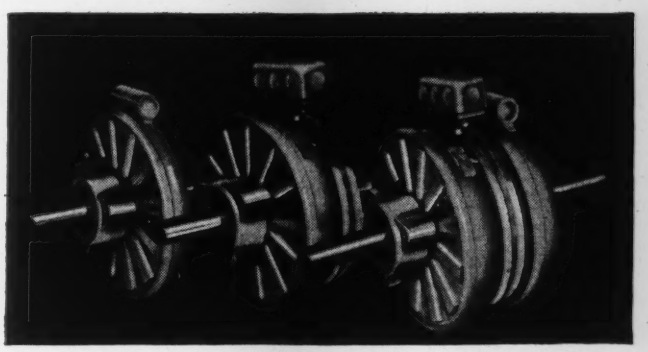
is to design your machine or its activating parts so that *you get:* (1) Push-button actuation at the machine or a remote control panel. (2) Fully or semi-automatic operation in "stop" or "start" of machine cycles. (3) Controlled acceleration or deceleration. (4) Automatic or manual adjustment of torque to load . . . or if your problem is *to eliminate:* (1) "Shock" from stop or start on gear trains and shafts. (2) Complex mechanical lever linkage, or air and hydraulic piping systems. (3) Vibration and hammering from solenoid operated brakes and clutches . . . or if you want to *increase production* from your machine by increasing the speed and number of cycle operations —



A WARNER ICB Unit installed on the drive of Rotary Baking Oven. Provides automatic positioning of trays for loading and unloading in continuous operation. Allows manual or automatic control.

A GOOD SOLUTION

to any one or combination of these problems is WARNER ICB Units. WARNER ICB Units are electrically controlled and operated clutches and brakes. They are compact, mechanically simple and may be applied to machine spindles, drive shafts, or direct to electric motors. Because of their design, they may be operated individually or in combination, manually or automatically, by direct or remote control. They provide for infinite controlled variation of torque in either clutching or braking action within their rated capacities. Their action is smooth and shockless—fast and practically noiseless. They are self-adjusting and self-compensating for life. Their design guarantees a high rate of heat dissipation.



From left to right: a Warner ICB Brake Unit, a Warner ICB Clutch Unit, and a combination Warner ICB Clutch and Brake Unit. Note clean, smooth, compact, appearance — simple mechanical parts.

MORE INFORMATION

on WARNER ICB Units and their application as clutches or brakes to various kinds of machinery is available. They may be used on continuous or intermittently operated machines. There is a complete range of sizes to meet both braking and clutching torque needs. If you have a design problem such as indicated above, write today for our free bulletin No. 701. If possible, state your problem. Not only will you receive your bulletin copy, but experienced WARNER ICB engineers will be glad to consult with you without obligation. Write direct to WARNER ELECTRIC BRAKE MANUFACTURING COMPANY, Beloit, Wis.

Bulletin 701 contains complete specifications and description of WARNER ICB Units. See for yourself how they offer advantages never before available on industrial clutches and brakes. Write for it today — no charge.

WARNER ICB UNIT

WARNER ICB Units are manufactured by Warner Electric Brake Mfg. Co. — pioneers in the field of electric brake design and application since 1927.

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- holds *leakproof* beyond tube bursting pressures.
- 3-piece design—remains *leakproof* after repeated reassembly.
- accommodates full range of standard tube wall thicknesses.
- made in steel, stainless steel, also aluminum alloy.
- shape bodies machined from forgings, other parts from bar stock.
- stocked by distributors across the nation.
- write for Parker "Industry Standard" Tube Fittings Catalog 203.

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superior room temperature fabricating properties. Workability of titanium and zirconium is increased at temperatures above 400 F.

Titanium sheet of low-impurity content can be bent on a radius two to three times its thickness. Other "commercially pure" titanium having higher carbon, nitrogen and oxygen contents seldom permits a 180-degree bend on a radius less than three or four times the thickness, and such material often cracks before it has gone much beyond 90 degrees.

With respect to deep-drawing characteristics, tests on annealed high-purity zirconium sheet of thicknesses from 0.020 to 0.005-in. yielded cup depths from 0.270 to 0.424-in. (hardness was from 74½ to 79 on the Rockwell 15T scale). These cup test test results are equal to, and in some cases better than, those obtained with commercial deep-drawing stock of stainless steel and nickel. It must be noted, however, that zirconium proved to be extremely sensitive to draw-ring radius, requiring a greater radius than the usual deep drawing sheet. It is understood that titanium exhibits similar characteristics.

The iodide form of zirconium, at least, seems amenable to impact extrusion. Stretch forming has been successful on titanium sheet of higher carbon and consequently lower ductility.

Galling and seizing characteristics are exceedingly troublesome in drawing and machining. Seizing is particularly severe with titanium, as evidenced in the cold drawing of tubing and wire. It has been reduced by purposely oxidizing the surface to prevent metal-to-metal contact; however, this practice can result in embrittlement. Metallic and solid-type resinous lubricants have been found which supply adequate lubrication for such operations. For reasons not altogether evident, the galling characteristic of titanium does not seem to be nearly as severe during machining operations.

Special Practices Required

Undoubtedly, further experience with titanium and zirconium will bring about the evolution of tool angles and grinding techniques particularly adapted to these metals. It should be remembered that tool forms best suited to steel were not well adapted to nickel alloys, aluminum, stainless steel and magnesium when these newer materials came along, and it is not to be expected that titanium and zirconium can be machined most efficiently with tools designed for common metals.

Need for special welding techniques

MACHINE TOOL BUILDER CUTS COSTS 26%

. . . increases rigidity with welded design

By James A. McCallum, Plant Superintendent
American Broach and Machine Company
Ann Arbor, Michigan

Heavier tool pressures, higher cutting speeds and closer work tolerances in modern machine tools require designs having greater inherent rigidity. In many cases, where the size and weight of a particular machine tool is limited, the increased strength must, of necessity, be gained through more efficient use of higher tensile metals. With welded construction, the engineer has at his command new freedoms of design, allowing him to place the right amount of metal in the right places and, at the same time, lower manufacturing costs by using less material, eliminating pattern expense and simplifying machining and assembly.

Typical benefits gained by converting machine tool designs to welded construction are illustrated in the fabrication of the main column for a vertical broach at the American Broach & Machine Company (Fig. 1). To eliminate the delays of preparing patterns and castings and speed delivery, upright members (Fig. 2-3) are now being fabricated by arc welding. Because of the uniform quality and thickness of the steel components, less metal needs to be machined from the fabricated assembly, cutting both shop time and tooling costs.

Savings in cost on the column member average 26% excluding an estimated cost of $2000 for patterns that have been eliminated as well as one week's time for snagging and filling castings. By cutting 6,000 pounds from the weight, reduced shipping costs are helping to lower the prices quoted to our customers.

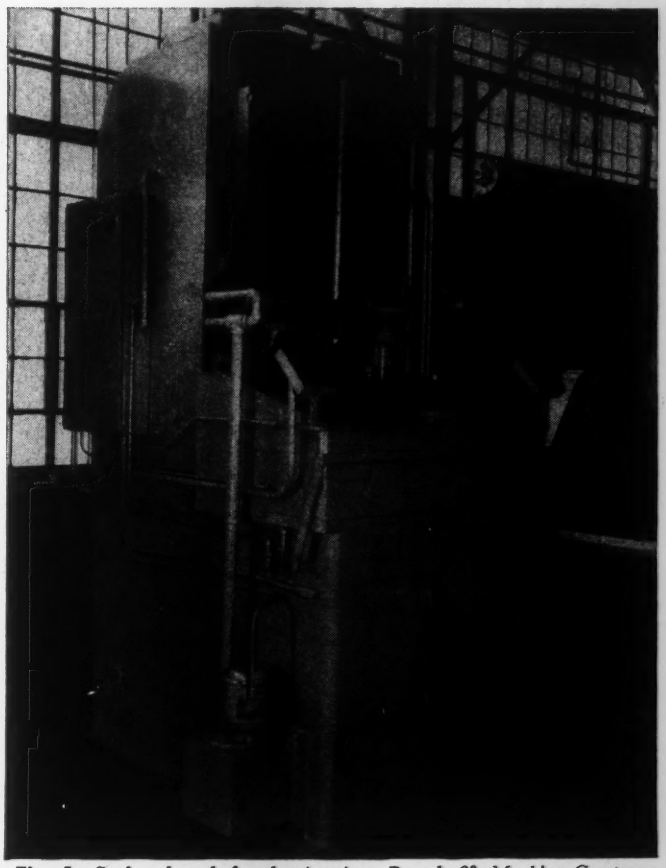

Fig. 1. *Surface broach for the American Broach & Machine Company, Ann Arbor, Michigan. Capacity 40 tons, height 15½ feet, weight 34 tons.*

Fig. 2. Greater rigidity with less weight. *Welded steel is 3 times stronger, 2½ times stiffer than cast iron, saves 6,000 pounds of metal on this main upright column member.*

Fig. 3. Modern streamline appearance. *Component parts are cut and formed to shape before fast, simple downhand welded assembly.*

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THE LINCOLN ELECTRIC COMPANY
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Fawick and only Fawick provides users with (1) 360° constant-velocity contact with the friction surface, (2) uniform-pressure axial contact between the full width of the friction surface and the drum, (3) unrestricted shock absorbing flexibility of the torque-transmitting rubber tube, (4) complete and sensitive torque remote control.

For specific information on all advantages of Fawick Industrial Clutch and Brake Units, write to the Main Office, Cleveland, Ohio, for Bulletin 300.

All desirable clutch characteristics are built into Fawick Airflex units

FAWICK Airflex CO., INC.
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FAWICK CLUTCHES = = PEAK EFFICIENCY

is indicated by the affinity of titanium and zirconium for nitrogen, oxygen and carbon. Fusion welding of tubing, for instance, is done under ample blanket of carefully controlled inert atmosphere. The technique is exacting if ductile welds are to be made because the weld must be protected both inside and outside to prevent gas absorption. Metal adjacent to the weld which attains a temperature of more than about 1000 F must be equally well protected.

To date, successful welding of titanium and zirconium to dissimilar metals has not been reported, but it has been reported that titanium may be brazed to dissimilar metals with alloys of titanium-copper and manganese-nickel. *From an article by Joseph Maltz and Vincent De-Pierre, metallurgists, U. S. Naval Gun Factory, appearing in Metal Progress, pages* 185-188, *August,* 1950.

Molybdenum Fabrication

KNOWLEDGE and experience with respect to the fabrication of molybdenum are becoming available in ever-increasing amounts. A number of organizations are now in a position to produce molybdenum parts that have been either drawn, spun, bent, or joined mechanically. Brazing methods which give tight, nonbrittle joints are available. At least one molybdenum-to-molybdenum weld that showed considerable ductility in spinning has been made.

Massive sintered molybdenum is being produced by Fansteel Metallurgical Corp., General Electric Co. and Westinghouse Electric Corp. Massive sinterings of molybdenum and molybdenum-rich alloys, measuring up to 6 in. square, 4 ft long, and weighing over 400 lb, have been produced successfully.

After heat treatment the densities of these pieces are essentially those of cast or melted ingots. Square or rectangular slabs have been produced to facilitate rolling, eliminating the preliminary forging step. The pieces so made are rolled directly with no machining or cutting away; hence, there is no excess metal to recover. The size of the rolling mill available limits the size of piece that may be fabricated at the present time. These statements also apply to alloys containing small percentages of cobalt and nickel.

Cast molybdenum ingots up to 6 in. in diameter and weighing 190 lb have been produced regularly by the Climax Molybdenum Co. After being machined to 5½ in. in diameter (165 lb), these ingots are forged to

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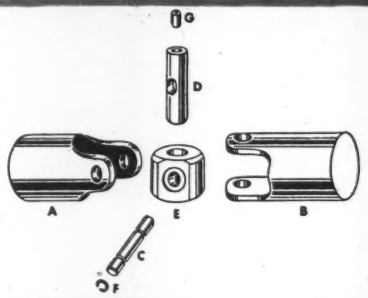

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Boston Gear Universal Joints are engineered for high load carrying capacity and high static torque ratings. They are compact, smooth running, long-lived. They equal or exceed Government Specifications in every respect.

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BEARING PINS (C & D) are hardened and precision ground.

CENTER BEARING BLOCK (E) is hardened and precision ground. Holes intersect accurately to provide true bearing surfaces.

SELF-LOCKING ASSEMBLY RING (F) of specially selected spring steel, snap locks into recesses in small bearing pins and center bearing block.

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BOSTON UNIVERSAL JOINTS, like all of the 101 Boston Gear Power Transmission Products and Parts are readily available from stock at your local Authorized Boston Gear Distributor. Name on request.

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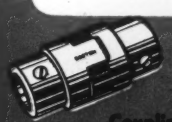
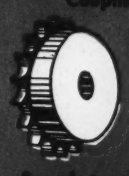


Couplings



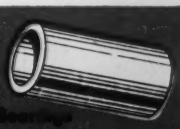
Sprockets

Reducers

Pillow Blocks

Reducers

Bearings



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Sliding linear motions are nearly always troublesome. Thousands of progressive engineers have solved this problem by application of the Precision Series A Ball Bushing.

The low-cost Commercial Grade Series B bearing is now added to the Ball Bushing line and offered to original equipment manufacturers. This ball bearing has been developed for support of linear motions in competitively priced, volume produced products where super precision is not essential. Alert designers can now make tremendous improvements in their products by using Ball Bushings on guide rods, reciprocating shafts, push-pull actions, or for support of any mechanism that is moved or shifted in a straight line.

Competition is returning. Up-to-date engineering can be *important to you!*

- LOW FRICTION
- ELIMINATE BINDING AND CHATTER
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- LASTING ALIGNMENT
- LOW MAINTENANCE
- LONG LIFE

NEW 1½" NOW AVAILABLE

New in production for ¼", ½", ¾", 1" and 1½" shaft diameters. If you have a catalog, phone your representative or write us for new Data Sheet. If not, write for complete literature and the name of our representative in your city.

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PROGRESSIVE MANUFACTURERS USE BALL BUSHINGS — A MAJOR IMPROVEMENT AT A MINOR COST

2 or 2½ in. and annealed as the metal work hardens. From this size, the metal is rolled in standard tool-steel passes to various rod sizes. The billets may also be rolled into sheets and strips, drawn into wire or extruded into tubing. Alloy ingots containing from 2 to 5 per cent tungsten are also cast; in fact, most of the material now being tested is the 2 per cent tungsten alloy.

Before the end of 1950 it is expected that ingots up to 9 in. in diameter and weighing about 1000 lb will be cast. With additional power, the same unit should produce 12-in. ingots weighing 2000 lb.

Flat forgings having a 5-in. diameter can be produced with relative ease; however, the size and power of the equipment used limit the finished product. Molybdenum is also available in small forgings having a diameter of 2½ in. or less.

Bar and rod are rolled at 2100 F in standard tool-steel passes and annealed when necessary to remove work hardening. Sheet may be cold rolled to various gages, down to 0.001-in. Hot rolling is usually done at temperatures below 1950 F. In single-thickness rolling, sheet is reduced to as low as 0.0625-in., whereas in pack rolling the reductions have been made to a gage of 0.010-in.

Straight-rolled and cross-rolled sheet in sizes up to 0.020 by 24 by 60 in. have been produced, and some rolling has been done on pieces approximately 6 in. thick and 4 ft long. Processes are known that will give a good degree of ductility both in the direction of rolling and across flat pieces ½ to 1-in. thick.

Seamless tubing is being made by extrusion and drawing to size. This tubing is available in dimensions up to ½-in. outside diameter in a number of wall thicknesses.

Adaptable to Many Processes

Molybdenum can be spun successfully into many shapes when heated to a temperature of about 400 F. Annealed cross-rolled material may be used. Deep drawing has been done with wall reductions between anneals up to 22 per cent. Experienced sheet metal workers can do "considerable" forming and bending of molybdenum. For example, a 0.010-in. thick sheet may be bent tightly on itself without breaking. However, such a sheet may fracture when attempts are made to straighten it. Lock-seam joints can be made, and various punching, stamping and forming operations may be carried out. Moderate heating is beneficial in these operations.

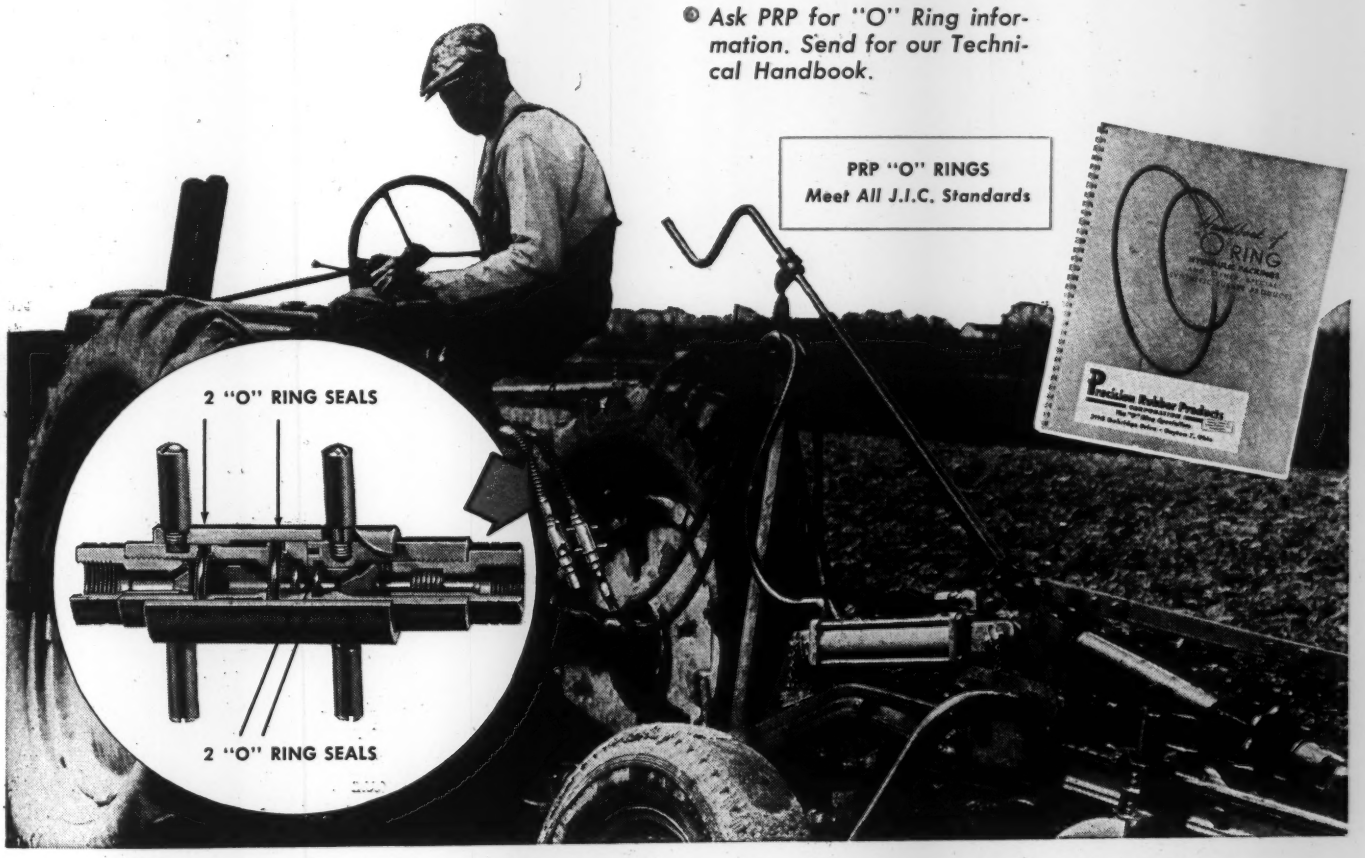
Considerable experimentation with

HITCHED FOR KEEPS!

Four "O" Ring Seals are vital components of this breakaway coupler, designed, manufactured and supplied by the DUKES COMPANY, Chicago, Illinois. This coupler, connected in the hoseline between tractor and drawn implement, separates and seals off automatically should the hitch disconnect; and can be recoupled with bare hands against all line pressures. The use of "O" Ring Seals makes the design of this coupler simple, practical and economical.

Unusual application? Not for PRP engineers, who have developed an amazing variety of "O" Ring applications to help solve knotty design and production problems. "O" Rings, lightweight and compact, provide leakproof service with gases, water, oils and special fluids. To learn what PRP can do for your product, write TODAY!

Ask PRP for "O" Ring information. Send for our Technical Handbook.



Precision Rubber Products
CORPORATION
Formerly Plastic & Rubber Products, Inc. Dayton, Ohio
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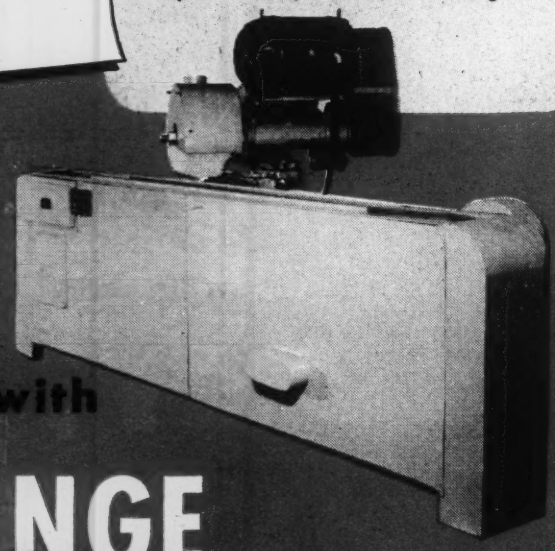
How would YOU choose Bearings to meet these tough "specs"?

APPLICATION: Main bearings for oscillating spindles in head of 5 h.p. Buffing and Polishing Machine.

ROTATING SPEEDS: 1800 to 3000 r.p.m.

RECIPROCATING ACTION: 1/2" stroke —120 cycles per minute, taken on rollers of bearing.

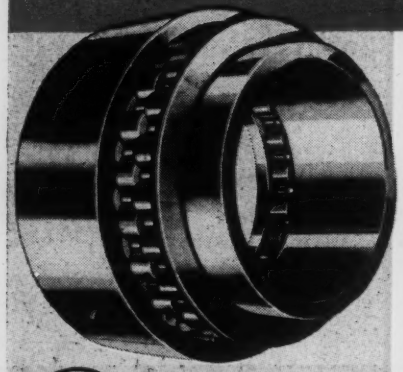
OTHER FACTORS: Severe service; varying work pressures cause temporary unbalances and shock loads. Wheel sizes up to 16" dia., 4" wide, 70 lb. weight.

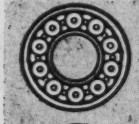


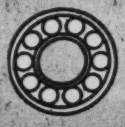
Divine Brothers Company solved it with

ORANGE

"STAGGERED" ROLLER BEARINGS







End views of Orange "Staggered" Roller Bearing and conventional bearing, show how staggered and meshed roller design brings a multiplicity of contact points within the loaded zone.

AFTER trials with other types of bearings, Divine Brothers Company, Utica, N. Y., found Orange "Staggered" Roller Bearings most satisfactory in meeting the radial capacity and axial shaft movement required in this unusually exacting application. All rotating and oscillating motion is carried on spindle and bearing rollers. Outer race is secured, bronze rings retain roller cage against oscillation, inner race is locked to shaft.

Because of the unique staggered roller design, these Orange bearings carry higher loads and do the work of larger size conventional bearings. They are precision running, extremely rugged. Full range of interchangeable sizes, in the 200 and 300 series, and in the 5200 and 5300 series. Special sizes to order. Write for Engineering Data Folder giving complete details.

ORANGE ROLLER BEARING CO., INC.
556 Main Street, Orange, N. J.

respect to welding methods for molybdenum must be done before it can be said that the molybdenum welding problem is solved and under control. Currently, gas-tight welds that will stand small shear and bending stresses can be produced, and these welds are probably capable of withstanding higher loads at elevated temperatures (say 1000 F).

Molybdenum may be brazed with silver brazing alloys or with platinum, palladium, or molybdenum eutectic alloys. Nickel in the brazing alloy is helpful. A nickel electroplate on the molydenum surface where brazing is to be done may also be used. One of the best brazing alloys, where strength and oxidation resistance through at least 2000 F are needed, is "Wall-Colmonoy No. 6" (essentially an Inconel containing 2 to 3 per cent boron). No brazing alloy is known that will withstand the conditions encountered when siliconizing is done after brazing.

Molybdenum and molybdenum-rich alloy surfaces must be protected where oxidizing conditions exist at 800 F and higher for periods longer than several minutes, dependent on temperature and permissible loss in thickness of molybdenum.

To prevent oxidation at elevated temperatures the following methods have been suggested: hot dipped aluminum coating, cladding, molybdenum disilicide and enamels. All these methods are successful to varying degrees but are limited under certain conditions.

A number of molybdenum binary alloys have been studied but further work must be done before detailed conclusions may be drawn. Nickel, cobalt and iron seem to be promising alloying agents from the standpoint of increasing hardness and tensile strength at elevated temperatures. In this respect, tungsten has less utility. Low-nickel and low-cobalt alloys produced by powder metallurgical methods have been studied extensively but published results are not available as yet. *From an article by Carl E. Swartz, consultant to NEPA Project and chairman, Metals Research, Armour Research Foundation, appearing in Metal Progress, pages* 181-184, *August,* 1950.

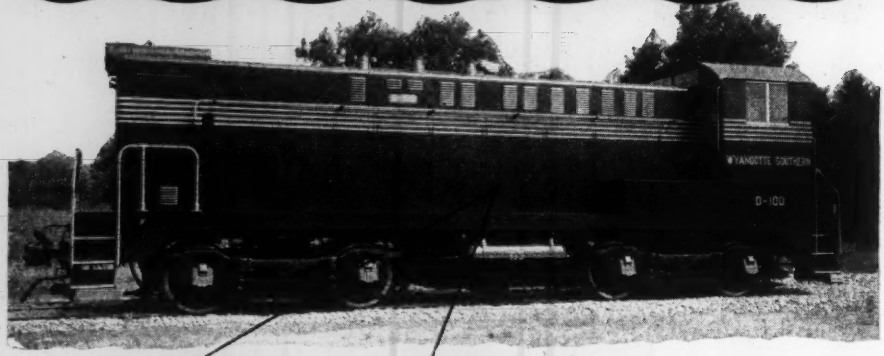
Rubber Phenolic Molding Materials

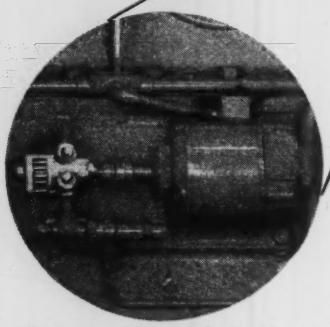
PHENOLIC molding materials are inherently strong but relatively brittle. Rubber is soft and tough. The combination of phenol-formaldehyde resin and synthetic rubber as a

Wallace Barnes Springs

Bristol Connecticut

ROPER Rotary PUMPS
SUPPLY FUEL TO BALDWIN LOCOMOTIVES





Close-up of Roper Series F Pump with mechanical seal . . . direct driven by separate electric motor.

A NOTEWORTHY EXAMPLE OF ROPER EFFICIENCY AND DEPENDABILITY

This Baldwin 750 HP Diesel Electric Switching Locomotive is dependent upon a small, compact Roper Rotary Pump for fuel supply. In this particular instance, the pump delivers 3 gallons per minute at 35 lbs. per square inch pressure; 1750 R.P.M.

ADAPTABLE TO A WIDE RANGE OF APPLICATIONS
1 to 300 G.P.M.
PRESSURES UP TO 300 P.S.I.

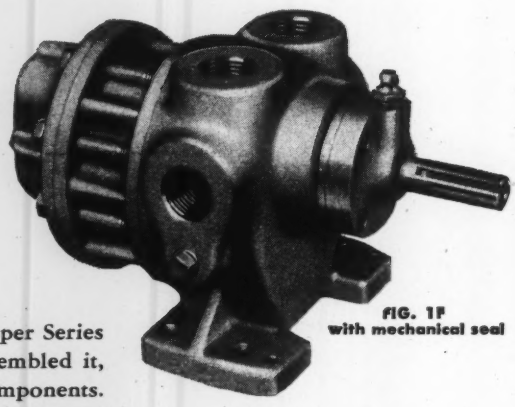


FIG. 1F with mechanical seal

Baldwin engineers put the Roper Series F through its paces . . . disassembled it, checked and rechecked all components. The result: Ropers have been selected as original equipment on Baldwin Diesel Electric Switching Locomotives. Were you to give the Roper Series F the "acid test", you'd find hardened, helical gears that run in axial hydraulic balance, flange-type bronze bearings, a deep packing box with split rings and split gland, other high-quality, carefully-made parts that make for the long service life you want and expect. Four-port design giving 8 optional piping arrangements facilitates installation. The Roper Series F is available in a wide range of sizes with or without mechanical seal; with or without relief valve.

ROPER Rotary Pumps

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Send for Bulletin
Ask for our general catalog. Outlines pumps in sizes 3/4 to 300 G.P.M.; pressures to 1000 P.S.I.

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250 Blackhawk Park Ave.
ROCKFORD, ILLINOIS

DEPENDABILITY SINCE 1857

binder for molding compositions offers materials with more desirable abuse-resistance without sacrificing moldability, bulk factor and other desirable characteristics of the standard phenolic molding powders.

Natural rubbers and phenolic resins are not compatible. Blends of the two materials result in products of nonuniform composition. American-made rubber, produced by copolymerization of Butadiene and Acrylonitrile, are more compatible with phenolic resins and have opened up new opportunities for the improvement in toughness characteristics of phenolics.

The first of the rubber phenolic formulations was a woodflour-filled molding powder. These materials were applicable to standard and automatic molding machines. Further developments were carried out with cotton flock filler, cotton fabric filler and asbestos fiber filler.

Standard impact tests do not illustrate the abuse resistance of rubber-phenolic materials. Many companies have investigated various methods of determining more accurately in the laboratory just what can be expected of rubber-phenolic moldings in service. Two conclusions have been reached in studying the data obtained. Rubber phenolics withstand shock loads 1½ to 8 times greater than phenolics alone, before first signs of failure, and withstand shock loads 2 to 15 times greater than straight phenolics before complete failure.

Some examples of the applications for these new products are:

Wood-flour-filled Rubber Phenolic: Soldering iron handles, electric sander handles, business machine parts, fan bases and knife handles.

Flock-filled Rubber Phenolic: Drum rims, textile spools, and textile spindles.

Fabric-filled Rubber Phenolic: Textile machine parts, handles for welding machines, rifle butts, and wire spools.

Asbestos-filled Rubber Phenolic: Electrical junction boxes, electrical switch housings, and textile tubs.

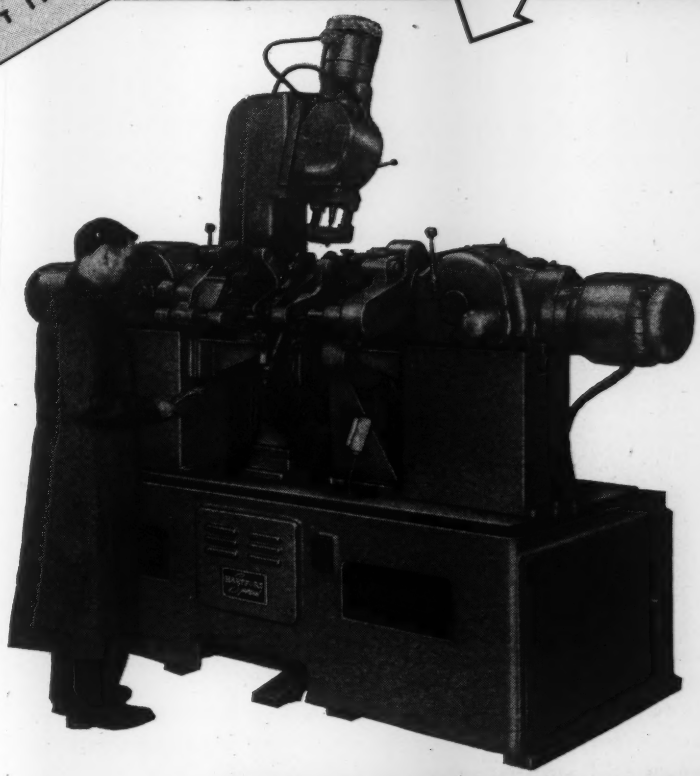
From a paper presented by W. Goss, General Electric Co., at the ASME Fall Meeting, Sept., 1950, *in Worcester, Mass.*

Plastics in the Textile Industry

THE word *plastics* has been applied to a great variety of materials. Webster defines the term as a material which is capable of being

150 PCS. PER HOUR...

drilled, chamfered, tapped & reamed on one Hartford Special Automatic Drilling & Tapping Machine



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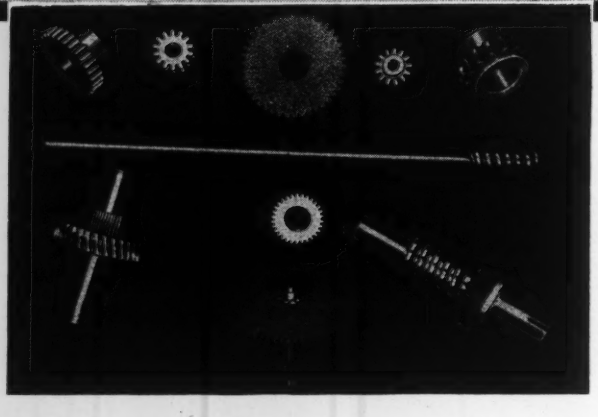
Rynel CERTIFIED FRACTIONAL HORSE POWER GEARS

For All Fractional Horse Power Purposes



Our special equipment for producing precision gears on a production basis enables us to meet your requirements at costs that will surprise you. If you require Spurs, Spirals, Helicals, Internals, Worm Gears and Worms, or Bevels, consult our gear experts. Write for complete information . . . or phone Sterling 3040.

New Bulletin MD-6 now available upon request.

Rynel Corporation
STERLING, ILLINOIS

molded, or one which can be deformed continuously and permanently in any direction without rupture. Such a definition certainly does not apply to the materials that are known the most as plastics. However, all plastic materials possess this form at some stage in their manufacture.

Of the host of synthetic-base materials and their combinations with various fillers, many are being adopted by the textile industry in place of other materials. The following classification segregates plastics in a general way:

Natural

Copals	Gum arabic
Rosin	Shellac
Natural protein (soybeans)	Rubber

Synthetic Thermosetting

Phenolics	Urea
Cresol	Melamine

Synthetic Thermoplastic

Polyethelene	Synthetic rubber
Nylon	Orlon
Vinal chloride (Saran)	Teralin
Poly vinyl alcohol	Styrene

The synthetics are by far the most widely used, and for industrial use synthetic materials known as filled thermosetting phenolics are the strongest, toughest, and most widely used.

Numerous Textile Applications

There are many applications in the textile industry which are well established for this type of material. The most common of these are given in the following list with short explanations of why plastics are applied.

Gears: Silent, long wearing

Pulleys: Light weight, less wear on cables, ropes and straps

Spinning buckets: Resistant to acid, strong, light weight

Separators: Smooth, light, no rough edges

Picker sticks: Stronger, less likely to break

Spools and bobbins: Light in weight, strong, wear resistant

One of the characteristics which makes these materials desirable for industrial use is the high strength-weight ratio. It is possible by varying the fillers and their combination with several resins to produce a large range of properties. In general, paper-base materials are used for electrical insulation, and fabric-base materials are used for mechanical applications.

From a paper presented by F. P. Hunsicker, Westinghouse Electric Corp., at the ASME Fall Meeting, Sept., 1950, in Worcester, Mass.

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

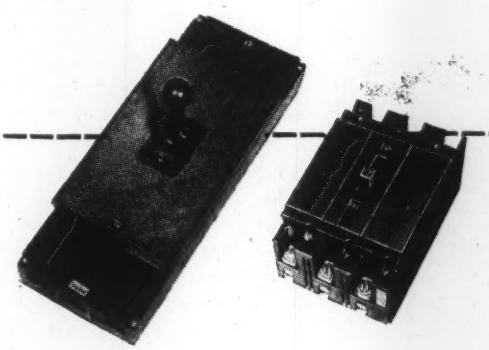
Onan uses compact AB BREAKERS to insure two-way safety

Protection against short circuits and overloads . . . in either the plane or the power energizer—that's the job AB Breakers do for Onan Ground Power Units. Here, in servicing Stratocruisers, speed is essential. Operational ease means time saved. Both requirements are answered by spacesaving AB Breakers.

Should trouble occur, AB Breakers provide instantaneous protection. And after trouble has been cleared, a simple flip of the handle restores the circuit. Think of the economy . . . no costly fuse to replace; no lost motion hunting for fuses that sometimes aren't there.

A glance at the panelboard above shows both E and L frame units fitted into a neat, compact arrangement . . . shows how they save valuable space. E frame units are used for ordinary circuits. L frame units protect heavy-duty requirements.

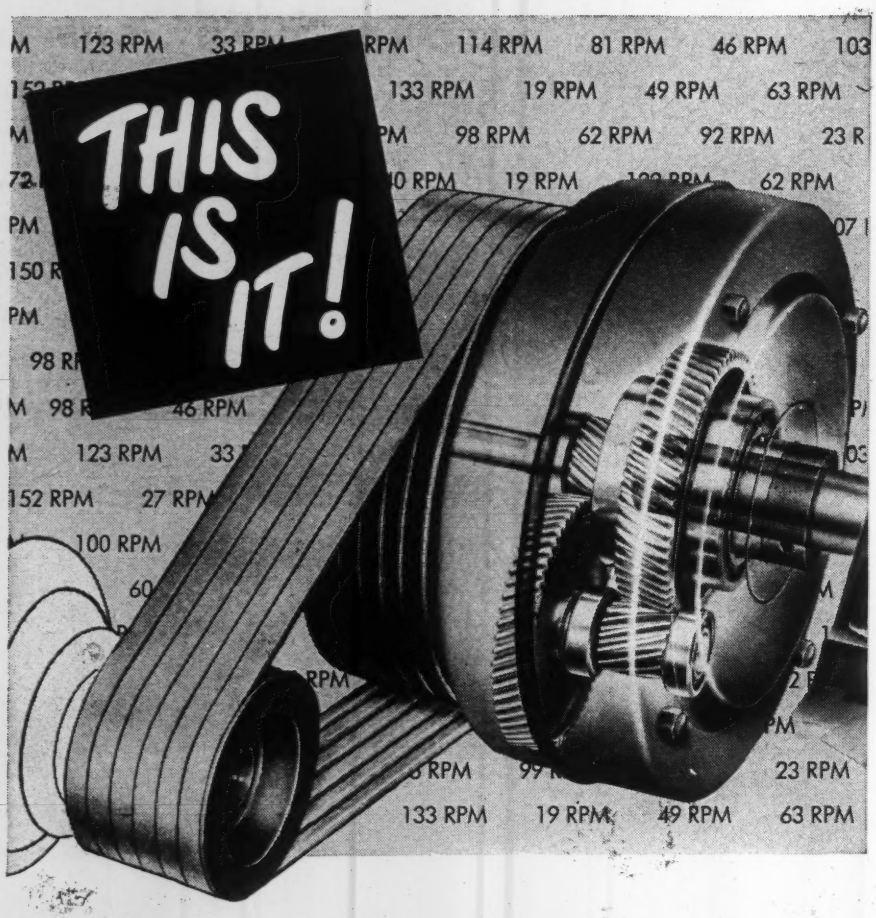
Westinghouse AB Breakers do any job with top performance, maximum safety and efficiency. See for yourself the impressive lineup of extra features. Contact your nearby Westinghouse representative now, for the moneysaving facts; or write for Bulletin D. B. 29-060, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-30026



Westinghouse

AB CIRCUIT BREAKERS

THE COMPLETE LINE



The *Original* Shaft-Mounted Reduction Drive That Simplifies the Design of Slow-Speed Equipment

Just seven sizes of standard American Reduction Drives will deliver *any* speed below 154 R.P.M. on drives up to 40 H.P. By simply selecting the proper ratios for the primary V-belt drive, engineers can provide just the speed their machinery requires.

No foundations are required because the unit mounts directly on the driven shaft. The result is a compact, modern, efficient slow-speed drive that can be specified easily by the engineer and installed easily by the shop.

Write today for complete engineering and selection information.

AMERICAN REDUCTION DRIVES

MAIL TODAY! *The American Pulley Company*
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At no obligation, send me complete information on American Reduction Drives.

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COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

NEW MACHINES

And the Companies Behind Them

Agricultural Equipment

CULTIVATOR: For nurseries, gardens etc. Powered by 4-cycle, air-cooled 3½-hp motor. Includes automatic centrifugal clutch controlled by throttle lever and geared transmission with roller chain drive to wheels and rotating cutters. Cutters consist of eight L-shaped hoes cover 16-in. wide strip. Weight, 145 lb; speed, ½ to 2 mph. *Jiffy-Till, La Mesa, Calif.*

Business Equipment

PORTABLE TYPEWRITER: New Finger-Flite Champion model has office size typewriter keyboard. Includes redesigned inner mechanism, tapered carrying case. Weight, including case, 16 lb. Finished in gray with maroon trim. *Underwood Corp., New York, N. Y.*

Commercial

LOW-TEMPERATURE CABINET: Self-service model for frozen foods, ice cream, etc. Features triple-pane glass top carried in stainless steel frame riding in recessed tracks. Cooled by Meter-Miser compressor unit. Capacity, 11.2 cu ft. Includes three aluminum dividers to provide four storage sections. Finished in white enamel. *Frigidaire Div., GMC, Dayton, O.*

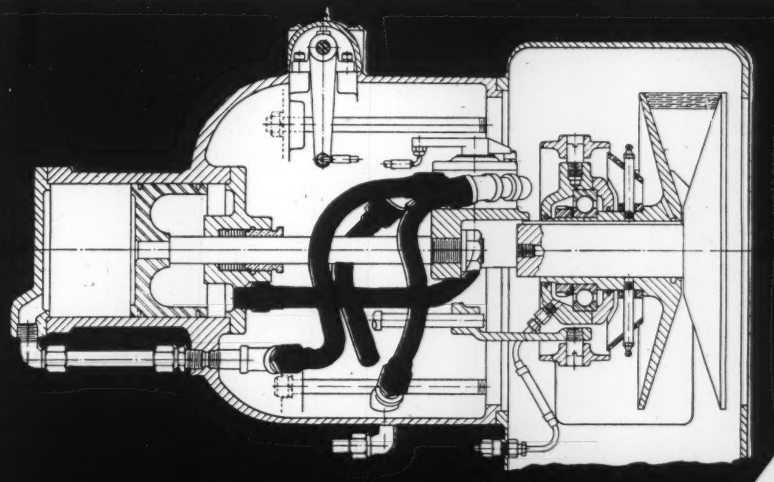
DISPLAY CASES: Endless construction type refrigerated cases for meats, dairy products, fruits and vegetables, etc. In 10-ft self-service and 10-ft clerk-service types. Positive locking arrangement permits fastening more than one unit together. Self-service model has open display section, 17.8 sq ft display area. Clerk-service model has 24.4 sq ft display area, is equipped with four service doors. *Frigidaire Div., GMC, Dayton, O.*

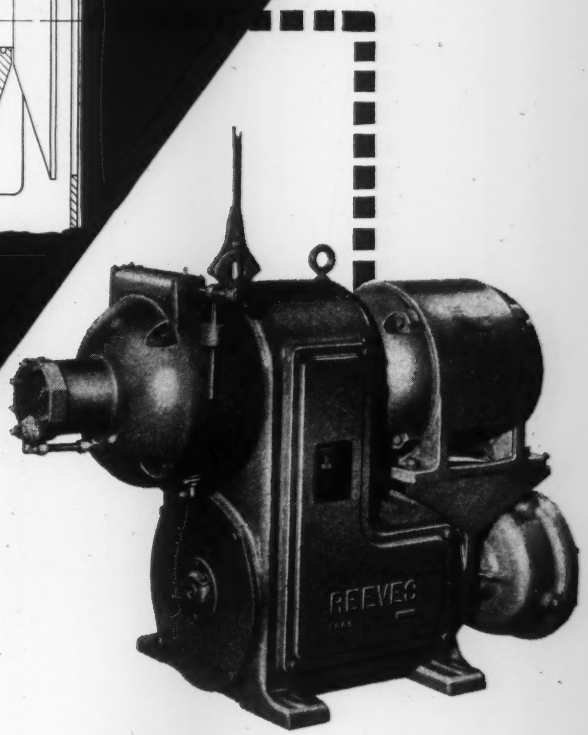
Domestic

CLEANER: Upright model electric cleaner in medium priced range. Styled by Henry Dreyfuss. Sweeper has wide front wheel, narrow rear wheel system of nozzle adjustment, two-position foot-operated range shifter, and foot-operated handle position control. Uses 11-degree helical brushes and beater bars, wide angle lamp and plastic furniture guard. *The Hoover Co., North Canton, O.*

ELECTRIC WATER HEATERS: Line of 10

NORGREN HOSES in Reeves Motodrive Test take 4,172,500 operating cycles with no sign of failure!

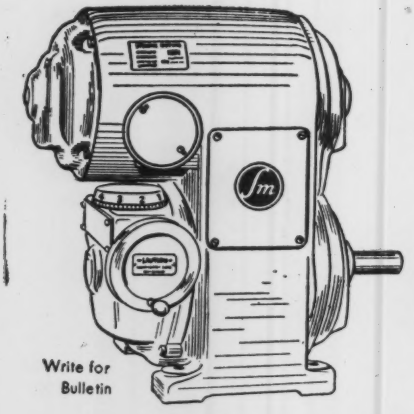




REEVES VARI-SPEED MOTODRIVES now offer ***hydraulic or pneumatic*** automatic control of velocity, tension, pressure, and temperature. Dependable hose performance is a "must" in this latest development in sensitive speed control... by Reeves!

For application Data Sheet No. 102, write C. A. Norgren Co., 242 Santa Fe Drive, Denver 9, Colorado

Uncork
Bottle-necks



Open up production bottlenecks with Sterling Speed-Trol Electric Power Drives.

STERLING
ELECTRIC MOTORS

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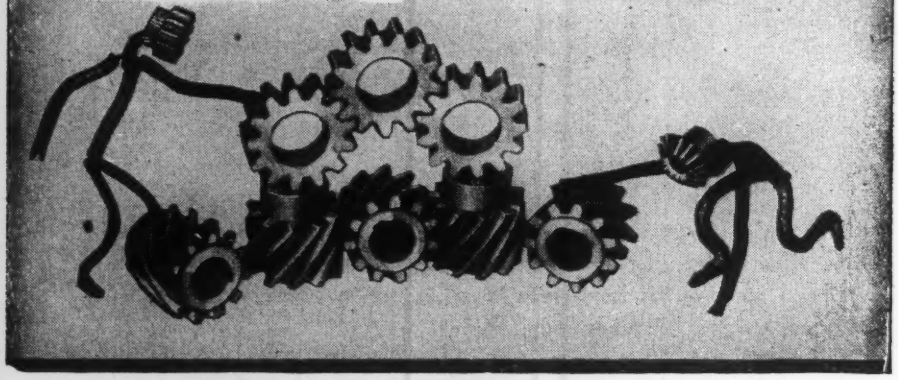
Mass. G&T Gear



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models from 30 to 80 gal capacity. Temperature automatically held between 120 and 180 F as desired. Steel tanks tested to 300 psi, have 3-in. spun glass wool insulation, with magnesium rod optional. Both 30 and 40-gal sizes available in table-top models. Standard units use 230-volt heating units; units of 1500 watts or less available for 115-volt on special order. *Frigidaire Div., GMC, Dayton, O.*

Heat Treating Equipment

HEAT TREATING FURNACE: Capacities, 1.8 to 20 cu ft. Temperatures obtainable, 0 to 2500 F. Furnaces have direct-reading pyrometers with calibrated energy input and atmosphere proportioning. Forced draft type burner operates on natural, manufactured or liquid petroleum gas. Solenoid cuts off fuel on electrical failure, relights on power return. Max outside temperature, 150 F. *A. D. Alpine Inc., Culver City, Calif.*

CORE BAKING TUNNEL: Electronic unit bakes cores evenly throughout. Since heat is generated within core, no heat is given off to room. Capacity, 4 tons per hour. Handles cores to 60 in. wide with combined core and core plate height of 20 in. Conveyor speed, 0 to 6 fpm. Overall floor space required, 8 by 8 by 25 ft. *Induction Heating Corp., Brooklyn, N. Y.*

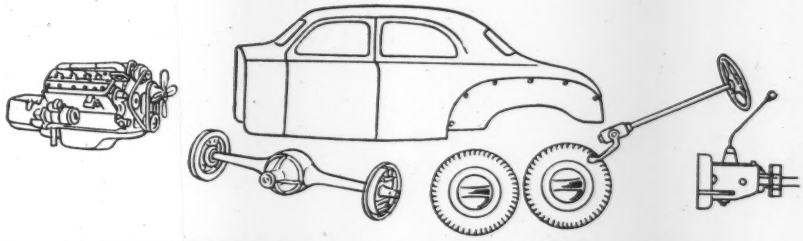
Heating and Ventilating

AXIAL PROPELLER FANS: Vaneaxial type, medium pressure fans for commercial or industrial ventilating equipment. Designed for series or straight-through applications in standard 20 or 24-in. duct systems. Equipped with open-ventilated, ball bearing, 40 C rise, standard NEMA foot-mounted motors. *Robbins & Myers Inc., Springfield, O.*

ELECTRONIC AIR CLEANER: Precipitron for upward or downward air flow to conserve floor space. Removes dust, dirt, soot, smoke and other air-borne solids from normal air electronically. Capacity, 1200 cfm and up. Small unit requires 4 sq ft, largest unit requires 16 sq ft. *Westinghouse Electric Corp., Boston, Mass.*

RADIANT GAS BURNER: Series of 18 models of horizontal type burners. Two impinging gas jets introduced into each of 16 oval tubes in face of burner block mix air and gas. Nine secondary air openings provide increased air entrainment to fire more gas per sq ft of surface. *Iron Fireman Manufacturing Co., Cleveland, O.*

ROOM AIR CONDITIONERS: One-room units for hospitals, offices, hotels, etc., to be attached to central sys-



YOU WOULDN'T buy a car this way

. . . so why buy hydraulics piecemeal ?

VICKERS Custom Built
HYDRAULIC POWER UNITS

When you buy an automobile you don't make separate purchases of engine, fenders, wheels, frame, axles, gear box, windshield, etc. and try to put them together. You buy a complete car, all in one piece. You don't want the expense and trouble of making the assembly. You *do* want the undivided responsibility of manufacturer and dealer for the complete car.

Why, then, buy hydraulics piecemeal when you can get a Vickers Custom Built Hydraulic Power Unit? It is built to meet your individual requirements. All necessary pumps, valves, intermediate piping, oil reservoir, motors, controls, etc. are in one self-contained "package." It includes all needed hydraulic accessories such as oil filters, air cleaners, oil level gauges, fittings, etc. Hydraulic connections are grouped in a conveniently located manifold.

The result is simplification of hydraulic design and substantial savings in installation and maintenance costs. Undivided responsibility of Vickers for the entire hydraulic system is an important advantage to both the machine builder and his customer. • *Write for Bulletin 50-61.*

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Draws a line 1/10th of a mile long with 1 filling!

WORLD'S ONLY DRAWING INK FOUNTAIN PEN

WITH INTERCHANGEABLE NIBS

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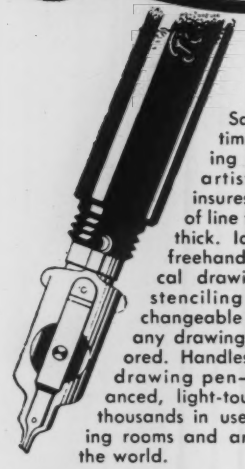

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tem but controlled individually. Two sizes; 200 to 350 cfm and 350 to 600 cfm. Furnished for direct expansion where few units are involved or for chilled water for large installations. Single switch converts unit for heating. Consists of finned coils, drip pan, casing, two double-width double-inlet fans, fan motor, filter and insulation. *Worthington Pump and Machinery Corp., Harrison, N. J.*

AIR CONDITIONER: Self-contained units for home, office, commercial use, etc. Cool, dehumidify, circulate and filter air. Package unit includes Freon-12 compressor, water-cooled condenser, direct expansion coil and fan. Requires water, drain and electrical connections. In 2, 3, and 5-hp sizes having cooling capacities of 24,000, 36,000 and 60,000 Btu per hour respectively. Smallest unit covers 22½ by 36-in. floor area, 68¾ in. high; largest unit is 22½ by 44 by 77 in. *Westinghouse Electric Corp., Boston, Mass.*

Maintenance Equipment

BATTERY CHARGER: Single-circuit model for charging 6-cell lead-acid batteries of up to 300 amp-hr capacity. Entirely automatic unit gives batteries complete charge in eight hours or less. Includes timer and temperature compensated voltage relay to control charge. *Motor Generator Corp., Troy, O.*

ELECTRIC GREASE GUNS: Two models with 25 and 40-lb capacities. Smaller unit delivers 14 oz of light or medium lubricant per minute at 70 F at pressures to 5000 lb. Dolly mounted, with rubber or steel wheels. Larger gun handles all types of grease, uses helix arm and worm gear priming, delivers 5½ oz heavy fibrous lubricant per minute at 70 F and 5000 pounds pressure. *Alemite Div., Stewart-Warner Corp., Chicago, Ill.*

Manufacturing

PORTABLE SPOT WELDER: Weight, 23 lb. Features fixed top tong, adjustable curved tips and handle at center of gravity to permit one-hand operation. Welds mild steel, stainless, galvanized iron, terne plate and magnesium up to ⅛-in. combined thickness. *Mid-States Welder Mfg. Co., Chicago, Ill.*

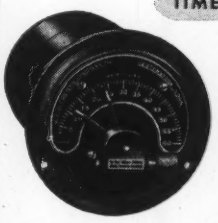
ROTARY-FIXTURE BENDER: For bending irregular shapes or true radii in tubing, bars, extrusions or roll-formed sections to 8 in. wide. Employs stationary pressure pad held against rotary die head by pneumatic cylinder. Die head mounted on vertical spindle powered by 7½-hp motor. Limit switches and adjustable dogs control degree of rota-

PRECISION— TIME CONTROL by Cramer

PERCENTAGE TIMERS

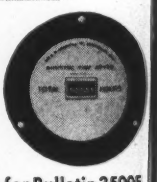
Automatically control the percentage of time at which circuit can be closed or opened out of a definite length of time. Adjusted from the front, can be set from 5% to 197% of total cycle. Write for Bulletin 2500G.

TIME DELAY RELAYS



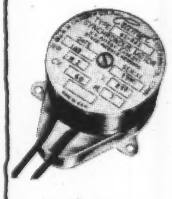
Provides adjustable or fixed time delay between closing and opening of a load circuit. Has automatic re-set feature which restores timer to its normal starting position when control circuit fails or is de-energized. Also available with reverse clutch which prevents re-set in case of power failure. Write for Bulletin 800H.

RUNNING TIME METERS



Synchronous motor driven, automatically and cumulatively register the total operating time or idle time on any circuit, machine or system. Also available with re-set feature. Write for Bulletin 3500E.

SYNCHRONOUS MOTORS



Efficient, powerful, self-starting synchronous motors for applications requiring constant speed at given frequency. Compact...precision-built... available with output speeds from 60 RPM to 1/24 RPH. Write for Bulletin 100.

If the performance of your product depends on precision timing, send us full particulars about your application. In developing a range of devices for a great variety of commercial and industrial timing duties, we have had wide experience in the design of equipment to meet many specific needs... and will welcome the opportunity to assist in solving your problem.

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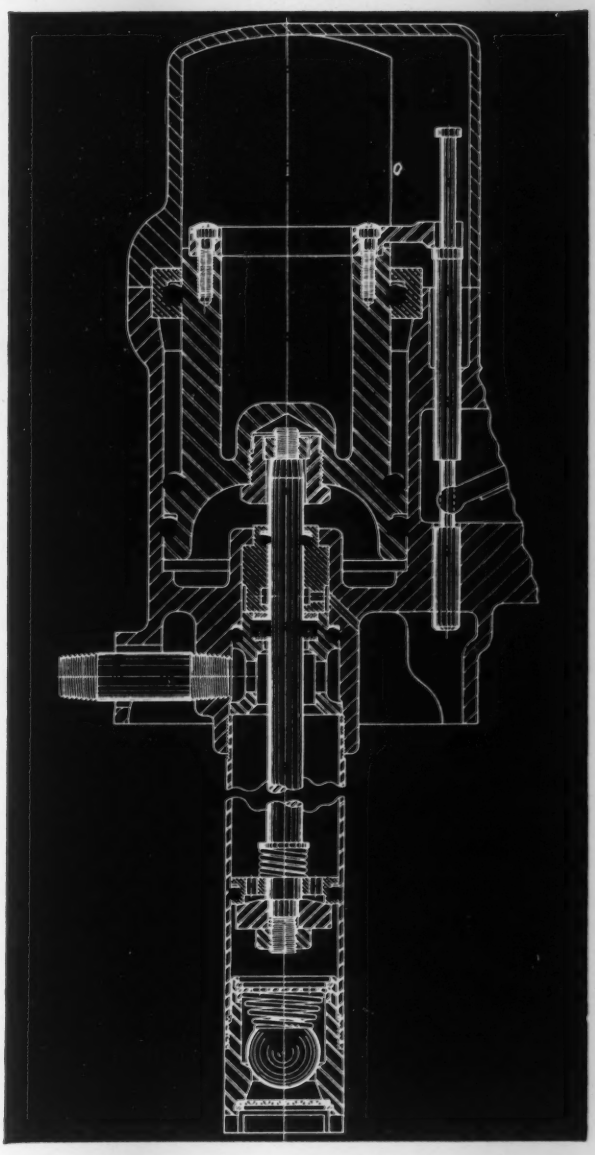

Balcrank, Inc. had a three-fold sealing problem with the new "Jet-Power" pump used for air-operated lubricating equipment. It required a seal capable of withstanding up to 190 psi air ... moisture varying with humidity conditions ... and continual friction under high-speed operation.

A severe life cycle test was devised by Balcrank to find a replacement for the unreliable leather seals previously used. During a period of 241 hours and 25 minutes, the pump's air piston made *4,892,900* strokes ... without benefit of a water trap in the air line or use of the automatic oiler. *Conditions were made extra tough!* LINEAR "O" Rings were used during the test ... were still sealing perfectly at the end of the run and upon examination showed little or no wear! That was conclusive proof of the superiority of LINEAR "O" Rings for even the most difficult sealing jobs.

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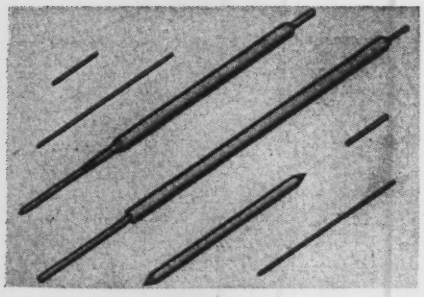

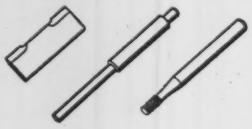

Special equipment and volume production enable us to save for you on a wide variety of precision metal parts.

For example, special shafts and pivots are made to order for meters, instruments, speedometers, tachometers, etc. Sharp, concentric, ground or swaged single or double points. Diameters .015" to 5/16". Lengths 3/16" to 10".

We are also set up to make such parts as special needles, rollers, shafts, studs, dowel pins, surgical and dental instruments, pen and pencil barrels, knurled mandrels and spindles, screw driver and ice pick blades, etc.

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Makers of
TORRINGTON NEEDLE BEARINGS

tion of die to give required bend. Adjustable slide mounting of air cylinder provides capacity for making 7-ft diameter bends. Standard cylinder stroke, 12 in. Requires 4 by 8-ft floor space, weighs 4500 lb. *Pines Engineering Co., Aurora, Ill.*

SUPERFINISHING ATTACHMENT: For cylindrical or flat work where a large area is to be covered. Mounts on engine lathe or other suitable equipment, is traversed along work while stones finish surface of part. For ground or machined surfaces. Attachment gives to 1000 psi pressure with adjustable oscillation rate of 42 to 250 strokes per minute. One to four stones to 1 by 1 by 6 in. can be mounted in holders. Operates on 220-v, single phase, 60 cycle a-c or d-c. *Gisholt Machine Co., Madison, Wis.*

ANGLE HEAD DRILL: For electricians, plumbers, etc. Head rotates through 360 degrees; when set at right angle, tool measures 7½ in. overall. Has two speeds: 275 rpm, for deep boring, 1100 rpm for small holes and drilling lumber. Capacity; ½-in. in steel, 4 in. in wood. *Cummins Portable Tools, Div. of Cummins Business Machines Corp., Chicago, Ill.*

WIRE STRAIGHTENING MACHINE: Operates on rotary principle. Capacity, $\frac{3}{32}$ to $\frac{9}{32}$-in. diameter wire. Feed rate, 56 to 181 fpm. Handles wire from reel, straightens and cuts in lengths from 3¼ up to 19½ ft in 3¼-ft increments. Wire subjected to repeated rotary bending to remove internal stresses. *American Pullmax Co. Inc., Chicago, Ill.*

SAW SHARPENER: Handles all types of circular saws from 4 to 48-in. diameter, having arbor holes from ½ to 2 in. Grinds straight or bevels teeth left or right from 0 to 45 degrees. Includes 3450-rpm motor, adjustable arbor and saw set. *Belsaw Machinery Co., Kansas City, Mo.*

SHAPER: Has 14-in. stroke, 26-in. ram, four speeds varying from 27 to 140 strokes per minute. Automatic horizontal feed motion gives four variations of feed per ram stroke. Table specifications: surface, 10 by 14 in.; max ram to table, 16 in.; longitudinal traverse, 16 in.; vertical traverse, 14 in. Max down feed of tool head, 5 in. *DCMT Sales Corp., New York, N. Y.*

TOOLROOM LATHE: Small precision Light Ten models take work to 10-in. diameter over bed. Swing over slide, 6¼ in.; distance between centers, 16⅛, 22⅛ and 28⅛ in. Back-geared headstock gives spindle speeds from 48 to 1435 rpm. Lead screw accurate within 0.0015-in. per

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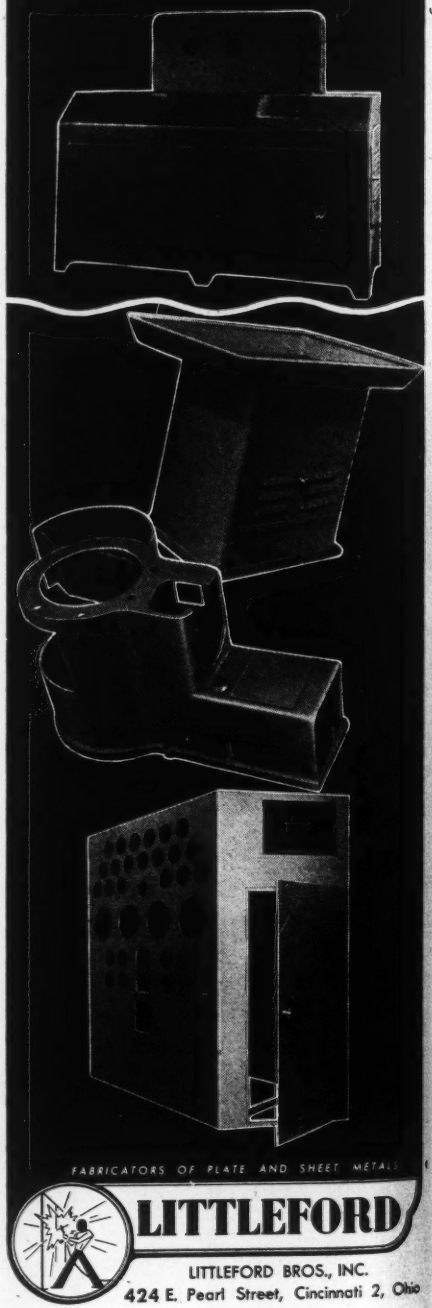
When designing new products remember Littleford can fabricate plain or alloy plate and sheet metal into any size or shape Weldment to fit your needs. Littleford Weldments for 68 years have played a vital part in many a product, such units as Bases, Guards, Pans, Louver Covers, or Special Parts have been produced at low cost by precision work and know how. Experience in bending, forming, shearing and welding is assurance of the high quality Weldments. Send blue prints to Littleford for estimates.



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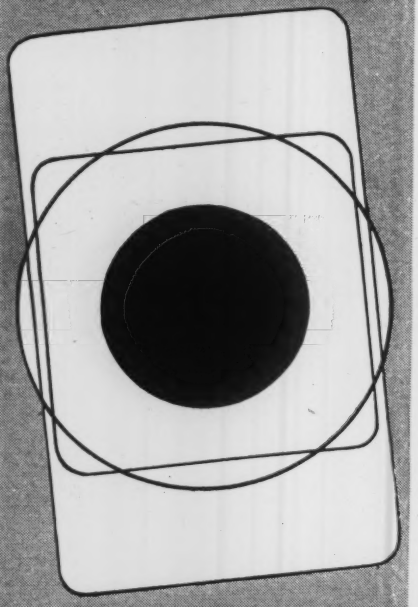
Products of the *world's largest specialty roll shop* at Ansonia are made for such diverse uses as processing rubber, plastics, linoleum, celluloid, phonograph record blanks, asphalt, asbestos, ink, paint, soap and textiles; calendering paper; rolling metal; grinding flour, coffee and sugar cane; crushing tobacco stems; and extracting oil from linseed and cottonseed.

Here rolls are designed and manufactured in sizes from 5" to 72" in diameter and up to 35 feet long overall, of chilled iron, alloy iron, gray iron, Meehanite® metal or steel. Highest grade materials are used and every manufacturing step, from metal mixture and casting, to grinding and inspection, is under constant, close contr

COMPARE
MOUNTING DIMENSIONS
— BORE FOR BORE



SEE WHY
O-M CYLINDERS
PACK MORE POWER
IN LESS SPACE

Tie rods and bulky end caps are eliminated on O-M hydraulic, water, air cylinders. Bore for bore you save at least a third in space required for mounting . . . or you pack more power in the same space.

All body parts are machined steel (not cast). All bearing surfaces bronze. Disassembly and repacking is done in minutes and mountings are interchangeable without disassembly. Ports adjustable to any angle.

A full line available in 1½ to 8 inch bores. Write today for details and specifications.

ORTMAN-MILLER
MACHINE CO., INC.
1210 150th Street, Hammond, Ind.

ft. Max collet capacity, ⅝-in.; hole through spindle, 3 7/32-in.; tailstock spindle travel, 2⅛ in. *South Bend Lathe Works, South Bend, Ind.*

Testing and Inspection

HOSE TEST MACHINE: For static testing of hose to 25,000 psi pressure. Air operated, unit is self contained. Includes necessary control valves, automatic quick-release valve, automatic air bleed valves, filter, and instruments. Two Sprague air-operated hydraulic booster pumps provide two pressure ranges, 0 to 1500 psi and 0 to 25,000 psi. Ten ft long sump with drain board serves as test chamber. *Sprague Engineering & Sales, Gardena, Calif.*

RADIATION COUNTER: Counts alpha, beta, and gamma particles. For use in counting samples and smears in health physics work, for analytical determination of disentegration rate, and in counting radiation of ore samples. Provides low background alpha counting and high efficiency beta and gamma counting. Sampling chamber can accommodate specimens to two-in. diameter. *General Electric Co., Schenectady, N. Y.*

UNIVERSAL TESTING MACHINE: Table model tester in two capacities, 15,000 and 30,000 lb. Loading is mechanical with crosshead speeds infinitely variable from 0.005 to 6 in. per minute. Weighing system consists of knife-edge pivot levers connected to calibrated steel elastic beams. Crosshead stroke, 14 in.; working space between columns, 20 in. Unit measures 18 by 64 in., stands 42 in. high. Weight, 1200 lb. *Testing Machine Div., National Forge and Ordnance Co., Irvine, Pa.*

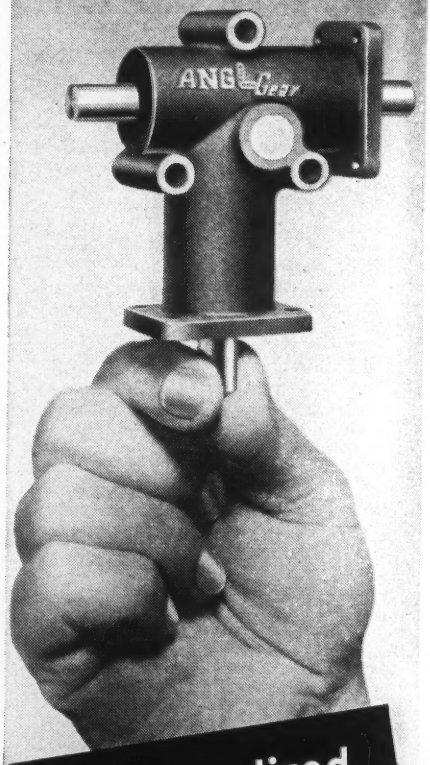
Transportation Equipment

DIESEL ENGINE: Model 6-110 provides 275 bhp at 1800 rpm. Six-cylinder engine has 110 cu in. displacement, 5-in. bore, 5.6-in. stroke. Has two-cycle operation, unit injectors, uniflow scavenging, and symmetrical cylinder head and block. Available as bare engine, with full equipment for marine or industrial use, or with special accessories. First used to power Budd RDC railcar. *Detroit Diesel, GMC, Detroit, Mich.*

Woodworking

BELT SANDER: Heavy-duty, 4-in. sander has 25 sq in. abrasive surface on work. Turbine fan vacuum system gives dust-free operation and longer belt life. Includes 115-v ac-dc, 25-50 cycle, single-phase motor, 4 by 27 in. belt with 1140 sfpm normal no-load speed, and 4 by 7 in. belt pad. Weight, 25 lb; overall size, 5⅝ by 18⅛ by 8⅜ in. *Porter-Cable Machine Co., Syracuse, N. Y.*

ANG Gear
TRADE MARK



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RIGHT ANGLE
BEVEL GEAR
UNITS

With Capacity of Units
Many Times Their
Size and Weight

Suitable for use in either manual or power operated systems beyond the limitations of ordinary commercial products. Two basic models meet the requirements of virtually all industrial applications. 1:1 or 2:1 ratio with either 2 or 3 shaft extensions.

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DIRECTORY OF MATERIALS

SEVENTEENTH EDITION

PURPOSE of this directory is to present in quick-reference form the key facts on tradenamed engineering materials. Data presented are those which the engineer needs in evaluating, selecting and applying these materials in the design of machines.

This directory contains three major interrelated listings: "Materials by Tradenames," an alphabetical listing which presents data on characteristics and representative machine applications; "Materials by Type," a cross index which aids in finding and comparing similar materials as well as in selecting materials based on alloy constituency; and "Materials Producers," an alphabetical list of company names and complete addresses along with the types and tradenames of materials produced by each.

Stainless steels, in addition to being included in the tradename section, are listed separately. Presented in this listing are data on the characteristics, uses and forms of standard AISI types. Stainless steel producers are also listed, together with data on types, forms and tradenames.

Included in the current directory are several new metals, plastics and nonmetallics; previous listings have been revised in accordance with present-day data. Every effort has been made to make this edition complete, authoritative and up-to-the-minute.

Machine Design gratefully acknowledges the fine co-operation of the materials producers whose contributions of data have made this directory possible.

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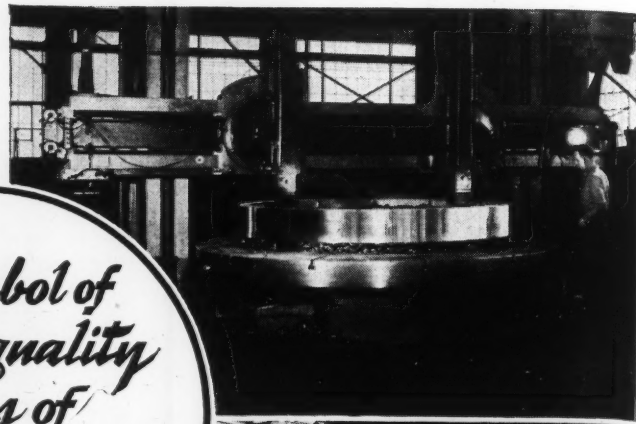

NE

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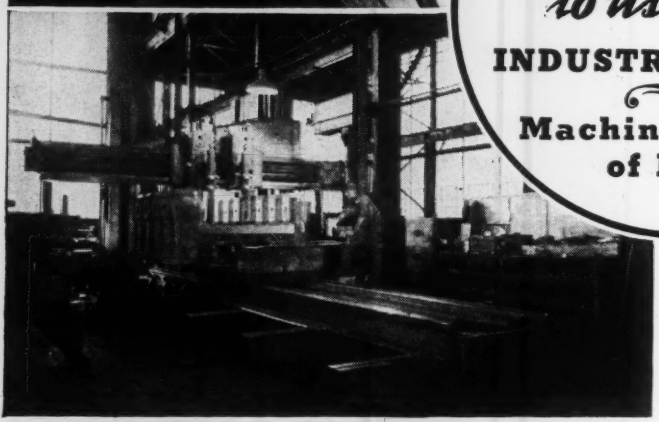
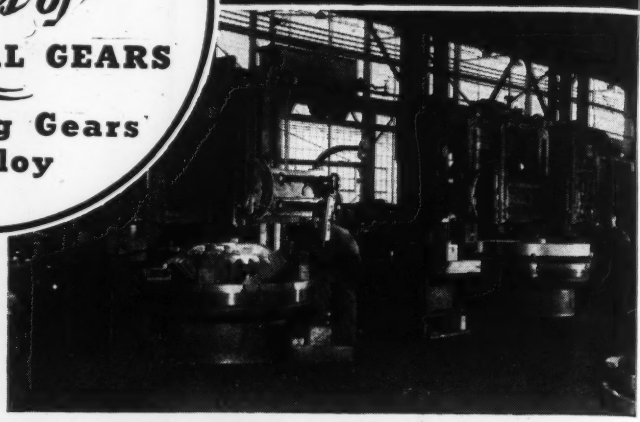
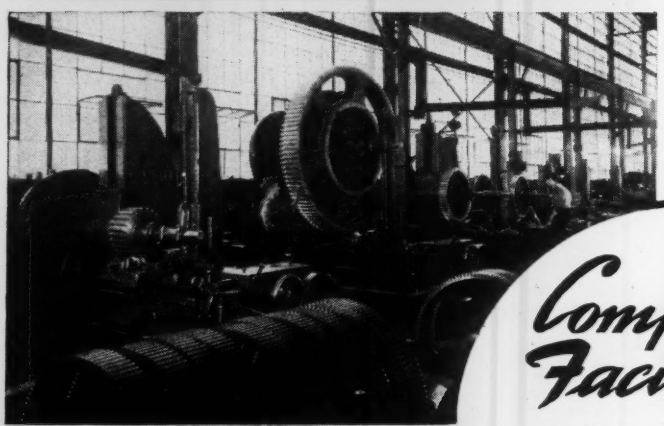
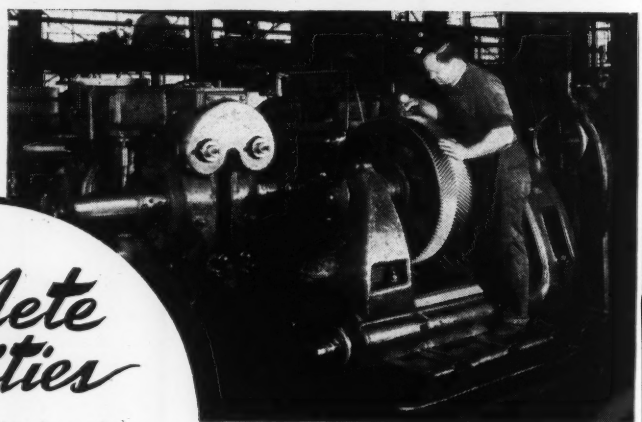
INDUSTRIAL GEARS

Machining Gears of Neloy









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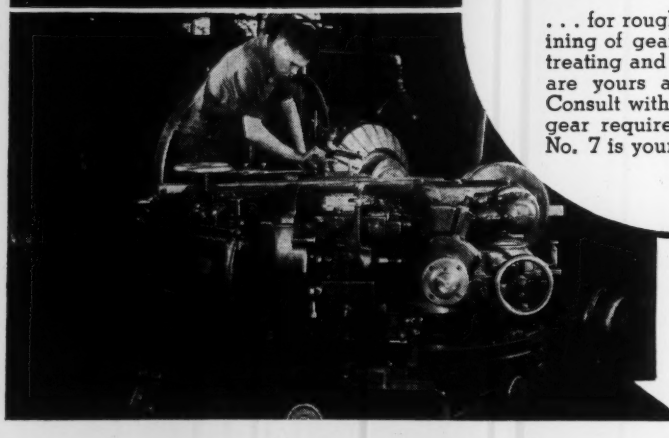
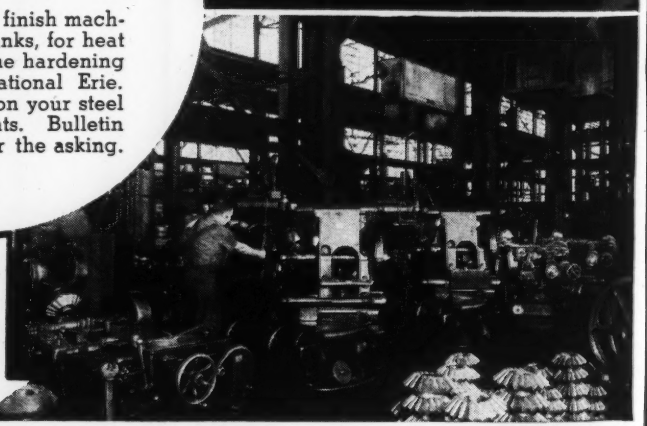
. . . for rough or finish machining of gear blanks, for heat treating and flame hardening are yours at National Erie. Consult with us on your steel gear requirements. Bulletin No. 7 is yours for the asking.





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DIRECTORY of MATERIALS

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Materials by Tradenames

All types of materials used for fabrication into machine parts are listed alphabetically by tradename.* Each listing includes type of material, name of producer and brief data on characteristics and representative machine applications. (For listing by producing companies with complete street addresses, see Page 316. For index of materials by type, see Page 313)

ABK METAL (Alloy steel castings) — Brake Shoe & Castings Div., American Brake Shoe Co., New York.

Ni-Cr alloy steel: Sand castings to specification. Ts, 30-60,000 psi; elong. (max. load) 0.10-0.35%; compr. str., 350-425,000 psi.; total compr. (max. load) 2.0-4.0%; mod. elas., 24-26 x 10^6 psi.; bhn, 500-700; magnetic; weldability, poor; abrasion resistance, very high. Used where castings are subject to severe abrasion and where intricate machining and high impact are not encountered.

ABRASOWELD (Welding electrode) — Lincoln Electric Co., Cleveland.

Arc-welding electrode for providing abrasion-resisting, self-hardening deposit which hardens rapidly under impact and abrasion; maximum hardness develops at surface, leaving cushion of softer metal beneath. Provides resistance to abrasion in straight carbon, low-alloy or high-manganese steel surfaces; effective on gear and pinion teeth.

ABSO-LUTE (Oxygen sealing compound)—Key Co., E. St. Louis, Ill.

Semifluid joint sealing compound for oxygen service in ½, 1, and 2-lb cans. Noncombustible and noncorrosive in oxygen service. For valves on oxygen cylinders and threaded connections on oxygen lines.

ACADIA (Synthetic rubbers)—Acadia Synthetic Products Div., Western Felt Works, Chicago.

Synthetic rubber compounds to meet Army, Navy and AMS specifications in sheets, extrusions and molded parts.

ACCOLOY (Stainless and heat-resistant castings)—Alloy Engineering & Casting Co., Champaign, Ill.

Analysis ranges from 18% chromium, 8% nickel to 68% nickel and 18% chromium. Static and centrifugal castings. Nonmagnetic; max cont serv temp, 2300 F. Weldability, good; abrasion resistance, low. For corrosion-resistant applications such as pump parts, tubing, chemical processing furnaces, etc., where resistance to corrosion and/or high temperature is required.

ACE (Hard rubber)—American Hard Rubber Co., New York.

Hard rubber, thermosetting: Sheets, rods or tubes and molded parts; machined, molded or extruded into parts. Moisture absorp, low; abrasion resistance, medium; chemical resistance, excellent in most acids, alkalies and salt solutions; attacked by strong oxidizing solutions; flexibility, medium; ts, 5-9000 psi; comp str, 12,000 psi; dielectric str, 475 (volts per mil inst); flex str, 15,000 psi; elongation, 3-6%; color range limited; shock resistance, high; opaque; sp gr, 1.18-1.2; Rock hdns, R95.

Heat-resistant hard rubber; Sheets, rods or tubes and molded parts, for molding, extruding and machining. Abrasion resistance, medium; chemical resistance, excellent, in most acids, alkalies and salt solutions; attacked by strong oxidizing solutions; flexibility, low; dielectric str, 400 (volts per mil inst); ts, 5-6500 psi; comp str, 10,000 psi; flex str, 8-10,000 psi; elongation, 1-3%; moisture absorp, low; color range limited; opaque; sp gr, 1.65-1.8%; shock resistance, medium; machinability, fair.

ACE SARAN (Vinylidene chloride plastics) — American Hard Rubber Co., New York 13.

Thermoplastic sheets, rods, tubes and injection molded parts. Abrasion resistance, medium; resistant to most inorganic and organic chemicals and solvents; max cont serv temp, 175 F; flex str, 15-17,000 psi; dielectric str, 350-400 (volts per mil inst); ts, 4-7000 psi; impact str (Izod), 0.3 to 1.0 ft-lb; black, straw color, red and brown; moisture absorp, 0.1%; sp gr, 1.7; translucent; machinability, good; Rock hdns, M50-65. For oil lines, air lines fittings, insulations, bushings, grommets, valve parts, etc.

ACIPCO (Cast irons and steels)—American Cast Iron Pipe Co., Birmingham 2, Ala.

Sand and permanent-mold castings of plain cast iron, alloy cast iron, Ni-resist, Ni-hard, plain carbon steels, and all grades of alloy steel including stainless.

ACME STRIP (Strip steel) — Acme Steel Co., Chicago 8, Ill.

Hot and cold-rolled strip steel; Sheets and strips (coiled) for stamping into parts. Furnished to specification; most sizes from ¼ to 22 inches wide, ¼-inch and less thick.

Glossary of Abbreviations

bhn	Brinell hardness number
coef thermal exp'n	coefficient of thermal expansion
compr set	compression set
compr str	compressive strength
dielectric str	dielectric strength
elong in 2 in.	elongation in 2 inches
fatigue str	fatigue strength
flex str	flexural strength
ft-lb	foot pounds
in./in./ deg C	inch per inch per degree Centigrade
imp str	impact strength
max cont serv temp	maximum continuous service temperature
moisture absorp	moisture absorption
%	per cent
psi	pounds per square inch
Rock hdns	Rockwell hardness
sp gr	specific gravity
ts	tensile strength
trans str	transverse strength
ys	yield strength

ACORN (Babbitt metal)—A. W. Cadman Mfg. Co., Pittsburgh.

Babbitt metal ingots: Bhn at 70 F, 23.8; at 212 F, 21.8; comp str, 12,500 psi. For bearings having reciprocating motion, subject to excessive pounding or vibration.

ACUSHNET (Rubber parts and products) — Acushnet Process Co., New Bedford, Mass.

Natural and synthetic rubber parts and products precision-molded to specifications or samples, on order. Rubber stocks compounded with properties to meet requirement and condition.

ADAMANT SUPER-GENUINE (Babbitt)—Magnolia Metal Company, Elizabeth, N. J.

Tough tin-base babbitt for high-speed bearings subject to extreme shock and pounding. Not to be used for slow speeds and heavy pressures. 90% tin, lead-free; bhn, 22.8; ys, 8,625 psi; pouring temp, 875-1050 F.

ADAMITE (Cast irons and steels)—Mackintosh-Hemphill Co., Pittsburgh, Pa.

C 1.80-3.25, Si 0.50-1.50, S 0.06, P 0.05, Mn 0.50, Ni 0.60, Cr 1.00. Sand castings to specification. Properties. heat-treated: Ts, 40-80,000 psi; ys, 20-60,000 psi; elong in 2 in., 0.10%; weldability, fair; max cont serv temp, 1500 F. For bending dies, steel mill guides, hammer dies, draw rings, etc.

ADVANCE (High copper-nickel alloy)—Driver-Harris Co., Harrison, N. J.

Cu 55, Ni 45. Thermocouple material. For applications where low-temperature coefficient of resistivity is required, such as in measuring instruments, industrial and radio rheostats and elevator controls.

AERISWELD (Welding electrode)—Lincoln Electric Co., Cleveland.

Arc-welding electrode. For welding of bronze, brass and copper, either in manufacturing or maintenance work.

AEROLITE (Safety glass) — Pittsburgh Plate Glass Co., Pittsburgh 19, Pa.

Thinnest safety glass. Made from two sheets of glass and plastic. Generally chemical resistant; nonflammable; ⅛ in. thick to maximum size of 30 x 40 inches.

AERTITE (Rubbery asphaltic-asbestos material) —Johns-Manville, New York 16.

Soft plastic form. Used on mechanical equipment to prevent air infiltration.

AFCOLOY METAL (Cast iron)—The Atlantic Foundry Co., Akron 4, O.

Cast iron to specification. Ts, 42,000 psi; comp str, 192,000 psi; impact str (Charpy), 7.5 ft-lb; bhn, 210; magnetic; machinability, good; weldability, fair. Used primarily in oil refinery machine field for liners, cylinders, dies, rams, etc.

AFCOMET (High-strength gray irons) — Atlas Foundry Co., Irvington, N. J.

Grade 30: Ts, 30,000 psi.
Grade 40: Ts, 40,000 psi.
Grade 50: Ts, 50,000 psi.

AFIRON (Gray iron)—Terre Haute Malleable & Mfg. Corp., Terre Haute, Ind.

Sand castings to specification. Properties, untreated: Ts, 30-50,000 psi; bhn, 207-260; magnetic; weldability, good when preheated at 700 F.

AGALOY (Tubing)—Agaloy Tubing Co., Springfield, O.

Welded and seamless tubing of carbon steels SAE 1010 to 1095, alloy steels SAE 4130 to 4150, SAE 6115 to 6195 and SAE 52100. Also redrawn copper-brazed tubing of SAE 1010 carbon steel.

Cold-drawn welded tubing of stainless steels AISI Types 304, 316, 317, 321, 329, 347 and 430. Cold-drawn seamless tubing of stainless steels AISI Types 304, 308, 316, 317, 321, 347, 410, 430 and 446. For property and application data, see "Stainless Steels" listing at end of this section.

Monel, Inconel and nickel tubing for applications requiring high resistance to corrosion, oxidation and scaling, combined with good strength at high temperatures, good ductility and impact strength at low temperatures.

Composite tubing made up of two or more different metals to specification.

AGILE (Arc welding electrodes) — American Agile Corporation, Cleveland 3, Ohio.

Agile White electrodes: Coated mild steel rods. For welding mild steel and low alloy

*The manner in which the tradenames and trademarks are set up or catalogued in this directory shall not be construed as denoting them generic or free for general use.

steel. Ts, 70,000 psi; ys, 60,000 psi; bhn, 160. For welding of ships, boilers and pipe lines, requiring a high quality weld deposit.

Red-White electrodes: Mild steel rods. For welding mild steel and low alloy steel in single or multiple-pass fillet production and fabrication welding, even on poorly fit-up assemblies. Ts, 70,000 psi; ys, 60,000 psi; bhn, 160. Meets AWS classification E-6012.

Blue-Red electrodes: Mild steel rods. For joining mild steel and low alloy steel. Ts, 70,000 psi; ys, 60,000 psi; bhn, 165. An all-position ac electrode recommended primarily for low open-circuit voltage transformers, as well as for general ac fabrication welding. Meets AWS classification E-6013.

Agile Brown electrodes: Coated mild steel rods. For welding thin and medium-heavy gage steel sections. Ts, 68,000 psi; ys, 60,000 psi; bhn, 160. Used for welding automobile bodies, truck and bus bodies, air conditioning equipment. Meets AWS classification E-6013.

Blue-Gray electrodes: Mild steel rods. For joining mild steel, low alloy steels, cold rolled and medium carbon steels. Ts, 60,000 psi; ys, 60,000 psi; bhn, 160. A semi-automatic (drag-type) electrode, furnishing high-quality, x-ray dense, weld metal of excellent appearance. Meets AWS classification E-6020.

Hardface electrodes: Rods of three different carbon-chromium-molybdenum alloy steels, composition depending on final hardness desired; bhn range, 250-600. For rebuilding machine surfaces exposed to wear, impact, slight corrosion, and requiring various degrees of hardness.

Toughface: Heavily coated manganese nickel electrode, bhn range, 200-500. Weld deposit work hardens rapidly and is extremely resistant to impact and abrasive wear. For refacing of crushing and grinding equipment, railroad frogs, switches, etc.

Yellow-M: Heavily coated copper-nickel alloy rod electrode, bhn, 160. For repairing and refacing cast iron machine parts, where machining after welding is required.

Yellow-Ni: Heavily coated nickel-core rod electrode; bhn, 160. For repairing and reclaiming cast iron machine parts, where ductile welds, machinable after welding, are required.

Bronze electrode: Heavily coated phosphor bronze core rod electrode. For joining brass, bronze and other copper-base alloys; also for joining steel and cast iron to bronze and for reclaiming cast iron parts.

Aluminum electrode: Rods of pure aluminum or aluminum plus 5% silicon alloys, flux coated. For welding commercially pure aluminum or other aluminum-base alloys.

Silver-Green: Alloy steel rods. Rock hdns, C 45-59. For repair and rebuilding of cutting edges exposed to impact and wear. For example, chisels, stamping dies, perforating dies, punches, etc.

Silver-Blue: Alloy steel rods. Rock hdns, C 48-54. For repair of cold working dies, broaches, gages. Weld metal nondeforming upon heat treatment.

Silver-Red: Alloy steel rods. Rock hdns, C 62-64. For building up high-speed cutting edges on tools such as planer and milling tools, high-speed drills, lathe centers, etc.

AGRICOLA (Bearing bronze)—Saginaw Bearing Co., Saginaw, Mich.

Cu 70, Pb 30; impurities less than 0.2 of 1%. Resists corrosion caused by acids; max cont serv temp, 500 F; ductility, medium. Especially adapted to diesel and airplane engine bearings.

AIRCO (Cast welding rods) — Air Reduction Sales Co. Div. Air Reduction Co. Inc., New York 17.

No. 1: Alloy steel rods for oxyacetylene welding of steels comparable to Grade A and Grade B pipe analyses.

No. 4: High tensile steel rod.

No. 5: Nickel steel rod for welding nickel, tool and other alloy steels.

RR: Chrome vanadium steel rod for producing wear-resistant surfaces.

No. 7: Mild steel rod for general welding.

No. 9: Cast iron rod.

No. 11: Carbon molybdenum rod for oxyacetylene welding of carbon molybdenum piping for high-pressure, high-temperature service.

No. 27, 20 and 22: Flux coated bronze rod for oxyacetylene brazing and welding.

No. 27: Low fuming bronze rod.

No. 22: Manganese bronze rod.

No. 20: Flux coated bronze rod.

No. 23A: Silicon copper rod offers high tensile strength, excellent color match for copper.

No. 25: Drawn aluminum rod for welding sheets of the common aluminum alloy compositions.

No. 26: Drawn silicon-aluminum rod for welding and brazing silicon-aluminum alloy products.

No. 718: Aluminum brazing wire.

AIRCO (Hardfacing electrodes)—Air Reduction Sales Co. Div. Air Reduction Co. Inc., New York 17.

No. 388: Shielded-arc electrode, coated. Deposit work-hardens to approx bhn 500; for building up surfaces to resist severe abrasion or shattering impact under service conditions where deposit work-hardens.

Self-Hardening: Fabricated rod made by rolling steel tape around alloy filler containing C, Cr, Mn, Si, Mo and Fe. Oxyacetylene application. Deposit hardness, Rockwell C53-57. For applications involving severe impact and abrasion. Deposit may be forged at red heat without loss of hardness or danger of cracking.

Self-Hardening: Extruded electrode, coated for electric application. Deposit hardness, bhn 500-600. For building up or surfacing areas subject to abrasion, impact or both.

No. 91: Shielded-arc electrode. For building up parts subject to rolling or sliding abrasion.

Tungtube No. 8: Fabricated rod consisting of tungsten-carbide particles encased within mild steel sheath. Oxyacetylene application. For parts requiring extreme resistance to earth abrasion.

Nos. 10, 20, 30, 40: Fabricated rods consisting of tungsten-carbide particles encased within mild steel sheath. Numbers indicate screen size of tungsten-carbide particles contained within tube. Tungsten-carbide particles embed in steel matrix, forming heterogeneous deposit. Gas or electric application. For parts requiring extreme resistance to earth abrasion.

No. 46: High-carbon lightly coated electrode. Hardness of deposit, bhn 250-450. For building up surfaces to resist impact and abrasion.

No. 53: Lightly coated electrode for use with direct current, reversed polarity. Bhn of deposit, 200-250. For deposits requiring more abrasion resistance than mild steel, yet machinable.

No. 82: All-position shielded-arc electrode. Bhn of deposit, 200-250. For applying machinable surfaces having more wear resistance than mild steel.

AIRCO (Stainless steel welding electrodes)—Air Reduction Sales Co., Div. of Air Reduction Co. Inc., 60 E. 42nd St., New York, N. Y.

19-9 Mn: Stainless AISI Type 307. Available in lime type coating for dc or titinia type coating for ac-dc application.

19-9: Stainless AISI Type 308. Available in lime type coating for dc or titinia type coating for ac-dc application.

19-9 Cb: Stainless AISI Type 347. Available in lime type coating for dc or titinia type coating for ac-dc application.

25-12: Stainless AISI. Type 309. Available in lime type coating for dc or titinia type coating for ac-dc application.

25-12 Cb: Stainless AISI. Type 309 Cb. Available in lime type coating for dc or titinia type coating for ac-dc application.

25-20: Stainless AISI. Type 310. Available in lime type coating for dc or titinia type coating for ac-dc application.

25-20 Cb: Stainless AISI. Type 310 Cb. Available in lime type coating for dc or titinia type coating for ac-dc application.

25-20 Mo: Stainless AISI Type 310 Cb. Available in lime type coating for dc or titinia type coating for ac-dc application.

18-8 Mo-Cb: Stainless AISI Type 310 Cb. Available in lime type coating for dc or titinia type coating for ac-dc application.

18-83.5 Mo: Stainless AISI Type 317. Available in lime type coating for dc or titinia type coating for ac-dc application.

35 Ni-15 Cr: Stainless AISI Type 330. Available in lime type coating for dc or titinia type coating for ac-dc application.

4-6 Cr-5 Mo: Stainless AISI Type 502. Available in lime type coating for dc application, only

9 Cr-1.0 Mo: Stainless available in lime type coating for dc application, only.

12 Cr: Stainless AISI Type 410. Available in lime type coating for dc application, only.

16 Cr: Stainless AISI Type 430. Available in lime type coating for dc application, only.

28 Cr: Stainless AISI Type 446. Available in lime type coating for dc application, only.

AIRCO (Welding electrodes) — Air Reduction Sales Co. Div. Air Reduction Co. Inc., New York 17.

No. 78, 78E, 79E, 87, 230, 315 and 90: For welding mild steels.

No. 90A: For welding mild steel and chrome-molybdenum steels.

No. 190: For welding aircraft alloy steels to be heat treated.

No. 93, 382, 94: For welding carbon-molybdenum and low-alloy, high-tensile steels.

No. 312, 394: For welding mild and alloy steels.

No. 91: For welds requiring resistance to sliding abrasion and shock.

No. 100: For welding aluminum bronze, manganese bronze, and cast iron.

No. 57: For welding aluminum.

No. 70: For welding phosphor bronze.

No. 72: For welding silicon bronze.

No. 77: For welding nonmachinable cast iron.

No. 375: Nickel for welding machinable cast iron.

AIRCOLITE R (Hardfacing alloy)—Air Reduction Sales Co. Div. Air Reduction Co. Inc., New York 17.

Principally Cr, Mo C and Fe. Cast rods in bare form for oxyacetylene application, or coated for electric application. Rock hdns of deposit, C56-60; max cont serv temp, 800 F; compr str, 320,000 psi. For building up surfaces subject to earth abrasion or metal-to-metal friction where impact is moderate and abrasion is severe.

AIRCOLOY R (Hardfacing alloys)—Air Reduction Sales Co. Div. Air Reduction Co. Inc., New York 17.

Nos. 1 and 6: Cast nonferrous alloys containing Co, Cr and W for oxyacetylene or electric application. No. 6 especially designed to resist corrosion, to maintain hardness, and to resist abrasion plus medium impact at elevated temperatures. No. 1 is similar but has higher hardness and superior abrasion resistance. Both are for hardfacing deposits to resist corrosion in service at temperatures above 700 F.

AJAX (High-carbon tool steel) — Kidd Drawn Steel Co., West Aliquippa, Pa.

Open hearth and electric furnace tool steels. Open hearth, C 1.00-1.20, Mn 0.30-0.50, P 0.04 max, S 0.045 max, Si 0.15-0.25. Electric furnace, same analysis with exception of C 1.00-1.10, and Mn 0.40 max. Finished bars, rods and wire. Slow heating treatment. 1425-1550 F; drawing temperatures depending upon size of section and hardness required. Bhn (as drawn), 197-207. For drills, taps, threading dies, etc.

AJAX (Hard rubber)—Vulcanized Rubber & Plastics Co., Morrisville, Bucks County, Pa.

Sheets, strips, rods and tubes. Abrasion resistance, high; max cont serv temp, 140 F; slow burning; flexibility, high; dielectric str (volts per mil inst), 470; ts, 7000-9500 psi; flex str, 10,000-15,000 psi; elong, 3.5-6.0%; moisture absorp, nil; black, brown and mottled; sp gr, 1.17-1.19; opaque; machinability, excellent; Rock hdns, R90-105.

ALADDIN ROD (Welding and brazing rod) — Aladdin Rod & Flux Mfg. Co., Grand Rapids 7, Mich.

For welding parts made of any of the zinc-base metals and for brazing aluminum. Rods 1/32 to ¼-in. diam. Ts, 47,300 psi; elong in 2 in., 8.4%; bhn, 83; sp gr, 6.8; melt pt, 733.6 F.

ALCLAD (Clad aluminum) — Aluminum Company of America, Pittsburgh.

14S: Same as Alcoa 14S composition; sheet, plate; ts, 61-68,000 psi. For general structural applications where high resistance to corrosion and high strength are required.

24S: Same as Alcoa 24S composition; sheet and plate; same strength as Alcoa 24S. For structural construction in aircraft.

75S: Composition same as Alcoa 75S. Sheet and plate. Ts, 76,000 psi. For structural uses in aircraft; strong aluminum alloy.

3S: Same as Alcoa 3S composition; sheet, plate and drawn tubing (inside coated only). Ts, 15-28,000 psi. For handling liquids where corrosion is a problem.

ALCOA (Aluminum alloys)—Aluminum Company of America, Pittsburgh.

2S: Commercially pure aluminum sheet and plate, rod, bar, wire, rivets, press forgings and impact extrusions. Ts, 13-24,000 psi. For sheet-metal work, chemical equipment and electrical conductors.

3S: Mn 1.2; Sheet and plate, forgings, extruded shapes, drawn and extruded tubing, rod, bar and wire. Ts, 16-29,000 psi. For sheet-metal work and gasoline tanks for aircraft and chemical equipment.

4S: Mn 1.2, Mg 1.0. Sheet, plate, tubing. Ts, 26-40,000 psi; for high pressure gas and

oil lines in automotive field.

11S: Cu 5.5, Pb 0.5, Bi 0.5. Wire, rod and bar, screw machine products. Ts, 55-59,000 psi.

14S: Cu 4.4, Si 0.8; Mn 0.8, Mg 0.4. Heat-treatable forgings, bar, extruded tubing and pipe, extruded and rolled shapes. Ts, 62-70,000 psi. For heavy-duty forgings, power shovel bails, airplane fittings, etc.

17S: Cu 4, Mn 0.5, Mg 0.5. Rod and bar, wire, and screw machine products. Ts, 62,000 psi. For structural applications in transportation fields.

A17S: Cu 2.5, Mg 0.3. Rivets and rivet wire. Ts, 43,000 psi. For aircraft; rivets can be driven in fully heat-treated condition.

18S: Cu 4, Mg 0.6, Ni 2. Heat-treatable forgings. Ts, 62,000 psi. For forged aircraft engine pistons where good strength at elevated temperatures is required.

24S: Cu 4.5, Mn 0.6, Mg 1.5. Sheet and plate, rod and bar, wire, drawn and extruded tubing, extruded shapes, rivets. Ts, 68-73,000 psi. For structural construction in aircraft.

25S: Cu 4.5, Si 0.8, Mn 0.8. Forgings for airplane propellers. Ts, 58,000 psi.

32S: Cu 0.9, Si 12.2, Mg 1.1, Ni 0.9. Heat-treatable forgings for pistons, low coefficient of expansion. Ts, 55,000 psi.

A51S: Si 1, Mg 0.6, Cr 0.25. Heat-treatable forgings for machine and automotive parts, especially for intricate forgings, ts, 48,000.

52S: Mg 2.5, Cr 0.25. Sheet and plate, tubing, rod, bar and wire; marine and transportation applications. Ts, 27-41,000.

53S: Si 0.7, Mg 1.3, Cr 0.25. Wire, rivets and screw machine parts; ts, 30-39,000 psi. For structures subject to severely corrosive conditions in naval and industrial applications.

56S: Mg 5.2, Mn 0.1, Cr 0.1. Rod, wire and rivets. Ts, 42-62,000 psi. For joining magnesium and for cable sheathing.

61S: Cu 0.25, Si 0.6, Mg 1, Cr 0.25. Sheet and plate, tubing, rolled and extruded shapes, wire, rod and bar and impact extrusions; ts, 35-45,000 psi. For applications in shipbuilding and transportation fields.

63S: Mg 0.70, Si 0.4. Extruded shapes, extruded and drawn tubing. Ts, 22-35,000 psi; for architectural applications, particularly when a pleasing anodic coating is desired.

75S: Cu 1.6, Mg 2.5, Zn 5.6, Cr 0.3. Sheet, plate, rod, bar, wire and extruded tubing and shapes. Ts (sheet), 82,000 psi; extrusions, 88,000 psi. For structural applications in aircraft.

13: Si 12; ts, 39,000 psi. General-Purpose die casting alloy for large, intricate parts.

43: Si 5. Sand, permanent-mold, and die castings. Ts, 19-30,000 psi. For castings that must be leakproof under pressure such as sewage disposal plant and pipe fittings.

85: Cu 4, Si 5. General-purpose die casting alloy for brackets, frames and levers with thick sections. Ts, 40,000 psi.

108: Cu 4, Si 3. Sand castings for manifolds, valves and other intricate castings requiring pressure tightness. Ts, 21,000 psi.

A108: Cu 4.5, Si 5.5. Permanent-mold castings. Ts, 28,000 psi. For general-purpose castings of intricate design.

C113: Cu 7, Si 3.5. Permanent-mold castings for automotive engine cylinder heads. Ts, 30,000 psi.

122: Cu 10, Mg 0.2. Sand and permanent-mold castings for automotive pistons, camshaft bearings, valve tappet guides. Ts, 27-48,000 psi.

A132: Cu 0.8, Si 12, Mg 1.2, Ni 2.5. Permanent-mold castings for pistons. Ts, 36-47,000 psi.

D132: Si 9, Cu 3.5, Mg 0.8, Ni 0.8. Permanent-mold castings for automotive pistons. Ts, 36,000 psi. General characteristics similar to A132.

138: Cu 10, Si 4, Mg 0.3. Permanent-mold castings for flat iron sole plates; retains strength and hardness at elevated temperatures. Ts, 32,000 psi.

142: Cu 4, Mg 1.5, Ni 2. Sand and permanent-mold castings for pistons and aircooled cylinder heads. Ts, 27-47,000 psi.

195: Cu 4.5, Si 0.8. Sand castings for general structural purposes. Ts, 32-40,000 psi.

B195: Cu 4.5, Si 2.5. Permanent-mold castings for general structural purposes. Ts, 37-45,000 psi.

212: Cu 8, Si 1.2. Sand castings for general purposes. Ts, 23,000 psi.

214: Mg 3.8. Sand castings. Ts, 25,000 psi. For marine fittings, machine parts, dairy and food handling equipment, fittings for chemical and sewage use; has high resistance to salt-water corrosion.

A214: Zn 1.8, Mg 3.8. Permanent-mold castings for marine fittings and hardware. Ts, 27,000 psi.

218: Mg 8. Die castings for marine fittings and hardware. Ts, 40,000 psi.

220: Mg 10. Sand castings. Ts, 46,000 psi. For aircraft fittings, railroad car parts, heavy-duty castings, power shovel dipper parts, marine applications.

355: Cu 1.3, Si 5, Mg 0.5. Permanent-mold and sand castings. Ts, 28-45,000 psi. For cylinder heads and crankcases for diesels and liquid-cooled aircraft engines.

356: Si 7, Mg 0.3. Permanent-mold and sand castings. Ts, 25-40,000 psi. For high-strength pressure-tight castings of intricate shape.

360: Si 9.5, Mg 0.5. Die castings. Ts, 44,000 psi; general-purpose alloy for large, intricate castings; a substitute for Alloy 13 for castings to be made in a cold chamber machine.

380: Cu 3.5, Si 9.0. High-strength general-purpose die casting alloy. Ts, 45,000 psi.

384: Si 12, Cu 3.8. General-purpose die casting alloy with slightly better casting properties than 380. Ts, 46,000 psi. Fair resistance to corrosion and good machinability.

113: Cu 7, Si 2, Zn 1.7. Sand and permanent-mold castings. Ts, 24-28,000 psi. For crankcases, oil pans, cylinder heads, and other automotive applications.

B214: Si 1.8, Mg 3.8. Sand castings. Ts, 20,000 psi. For pipe fittings, etc.; has high resistance to salt water corrosion.

F214: Si 0.5, Mg 3.8. Sand castings. Ts, 20,000 psi. For architectural applications and hardware; provides light-colored anodic coating.

319: Cu 3.9, Si 6.3. Sand and permanent-mold castings. Ts, 27-40,000 psi. For general purposes.

333: Cu 3.8, Si 9, Mg 0.4. Permanent-mold castings. Ts, 34-42,000 psi. For automotive pistons.

750: Cu 1, Ni 1, Sn 6.5. Permanent-mold castings. Ts, 20,000 psi. For bearing inserts in high-duty internal combustion engines as connecting rod, main and thrust bearings.

2S: Commercially pure aluminum sheet and plate, rod, bar, wire, rivets, press forgings and impact extrusions. Ts, 13-24,000 psi. For sheet-metal work, Chemical equipment and electrical conductors.

3S: Mn 1.2. Sheet and plate, forgings, extruded shapes, drawn and extruded tubing, rod, bar and wire. Ts, 16-29,000 psi. For sheet-metal work and gasoline tanks for aircraft and chemical equipment.

4S: Mn 1.2, Mg 1.0. Sheet, plate, tubing. Ts, 26-40,000 psi. For high-pressure gas and oil lines in automotive field.

11S: Cu 5.5, Pb 0.5, Bi 0.5. Wire, rod and bar, screw machine products. Ts, 55-59,000 psi.

ALCUPLATE (Composite aluminum-copper) — General Plate Div. of Metals and Controls Corp., Attleboro, Mass.

Al 90, Cu 10; Al 80, Cu 20; Al 70, Cu 30. Aluminum on copper or copper on aluminum laminated material. Straight and coiled strips and sheets. Hardness number, as specified. For electrical connectors, terminals, clamps, etc., wherever copper and aluminum are used.

ALDECOR (Alloy steels) — Alloys Development Co., Pittsburgh, Pa.

Steel containing Mo, Cu, Si, and P. Rough bars or billets, finished rods or bars, straight and coiled strips, sheets and plates for turning, boring, forging, stamping and welding. Properties, untreated: Ts, 70,000 psi min; ys, 50,000 psi min; elong in 2 in., 22% min; sp gr is same as ordinary steel; weldability, good; resists corrosion caused by atmospheric exposure; abrasion resistance, medium. Used in transportation equipment to reduce dead-weight. Also produced by Republic Steel Corp.

AL-FIN (Aluminum bonded to ferrous metals) —Al-Fin Div., Fairchild Engine and Airplane Corp., Farmingdale, N. Y.

Aluminum and its alloys chemically bonded to steel and iron by a casting process. Bond ts, 11-17,000 psi; bond hardness, 875 Vickers Diamond Brinell. Vibration and leak proof to hot oil and diatomic gases. For producing bi-metallic gears, pistons, sleeve bearings and bushings, cylinder barrels, heat exchangers, eddy current clutches, glass molds, truck, bus, trailer and aircraft heavy-duty brake drums, engine and machinery housings with reinforcements, electronic tube cooling radiators, etc.

ALLCAST No. 60 (Aluminum alloy) — Apex Smelting Co., Cleveland 5, and Chicago 12.

Nominal composition: Cu 3.5, Si 6. Ingots for sand, precision and permanent-mold castings. Typical properties, as-sand-cast, untreated: Ts, 28,000 psi; ys, 17,000 psi; elong, 2.5; bhn, 70. Range of typical properties under various heat treatments: Ts, 37,000-47,000 psi; ys, 24,000-42,000 psi; elong, 1.0-3.0; bhn, 85-105; sp gr, 2.73; nonmagnetic; weldability, good; abrasion resistance, medium. A general all-purpose aluminum alloy which is used in the as-cast or heat-treated condition, to meet a variety of applications, ranging from ornamental to highly stressed castings.

ALLEGHENY GRADE 609 (Shock resisting steel) — Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

C 0.60, Mn 0.80, Si 2.00, Cr 0.25, Mo 0.25, V 0.20. A silico-manganese shock-resisting steel for heavy duty springs, collets, press clutch parts, stressed bolts and studs, die head bodies, shafts, and other machine parts subject to shock and wear. May be hardened in oil or water.

ALLEGHENY LUDLUM (Alloy Steels) — Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

"4750": High-permeability nickel-iron alloy containing approx. 48% nickel, balance iron, that must be hydrogen annealed after fabrication. Sheets, flats, squares, strip, etc.; also laminations and shields. Used in audio transformers, sensitive relays, and electrical instruments.

"88-x": Typical analysis—C 0.25, Mn 12, Ni 8, bal., Fe. Nonmagnetic high-strength alloy, not at all stainless which finds applications for mountings in power transformers, and on high-current bus boards in power generating stations and substations.

Electrical steel: Coiled strip and sheets for manufacture of laminations. Used in construction of motors, transformers, relays, electromagnets, radios, etc. Contain ½-5% silicon, depending on application.

Relay steels: Annealed silicon steel rounds, flats, squares, etc., containing ½-2¾% silicon. Find wide application for relays, electromagnets, etc.

Laminations for transformers, motors, and miscellaneous small electrical equipment and parts. Made from all grades of silicon steel and from high-permeability alloys, such as Allegheny Ludlum "4750" and Allegheny Ludlum Mumetal.

Cast resistance grids: No. 17 metal. Castings having high electrical resistance and ability to withstand continued severe mechanical shock even at high temperatures. Applications include motor starters, crane motor controls, mine locomotive controls, and power house equipment.

ALLEGHENY METALS (Stainless Steels)—Allegheny Ludlum Steel Corp., Pittsburgh 22. Pa.

Standard stainless steels of AISI Type. For type, application and characteristic data see "Stainless Steels" listing at end of this section.

ALLEGHENY METAL, STAINLESS CLAD (Stainless-clad mild steel)—Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

Combination of mild steel and stainless steel; sheets, strips, and plates for general fabrication. Corrosion resistant. Combines qualities of the stainless steel and plain steel of which it is composed.

ALL-STATE (Welding and brazing rods and solders)—All-State Welding Alloys Co. Inc., White Plains, N. Y.

No. 1: Cast-iron welding rod. Properties of weld: Ts, 48,000 psi; bhn, 80-100; machinability, good; max cont serv temp, 1200 F; abrasion resistance, low. For welding cylinder blocks and heads, gearboxes, housings, etc.

No. 2: Machinable cast-iron electrode; copper-nickel. Weld properties: Ts, 30,000 psi; bhn, 80-100. For motor blocks and heads, filling blow holes in castings, building up errors in machining, etc.

No. 4: Fully machinable cast-iron electrode, approximately 100% nickel. Weld properties: Ts, 30,000 psi; bhn, 80-100; machinability, good; max cont serv temp, 2000 F; abrasion resistance, low. For welding cylinder blocks and heads, gearboxes, housings, etc.

No. 7: Cast-iron solder, tin-lead-zinc composition. Rods and bars for welding cast iron. Weld properties: Ts, 1000 psi; bhn, 30. For low-temperature application; for welding motor blocks and heads, and filling blow holes in castings, etc.

Nos. 11 and 13: Flux coated or bare nickel-silver welding rods for welding all ferrous and nonferrous metals with exception of aluminum and die-cast metals. Weld properties: Ts, 100-160,000 psi; bhn, 180-220. Resists corrosion caused by all salts with exception of ammonia. For carbide tips, extensions on drills, cutters, bits, shafting, drive splines, trolley shoes, gear teeth, gearboxes, etc.

No. 21: Phosphor-copper welding rods and bars. For joining all copper and copper-bearing alloys. Weld properties: Ts, 40,000 psi; ys, 35,000 psi. For use on buss bars, electric contact points, circuit breakers, refrigeration units, etc.

No. 23: Phosphor-copper-silver welding alloy rods; for joining copper and copper-bearing alloys. Weld properties: Ts, 50,000 psi; ys, 40,000 psi; resists corrosion by weather and milk acids. For use on buss bars, contact points, electrical units, refrigeration units, copper coils, circuit breakers, bronze bushings, etc.

No. 25: Welding rod of fabricated copper with strip of silver and flux included. Ts, 48,000 psi; elong, 30%; corrosion resistance, same as pure copper; electrical conductivity, 101%; ductility, very high. For joining heavy copper sections.

No. 31 and No. 33: Aluminum brazing alloy rods for joining aluminum alloys. Joint properties: Ts, 30,000 psi; as resistant to any corrosive agent as parent metal. For joining sheet and cast aluminum, broken aluminum castings; close color match.

No. 37: Aluminum solder rod for filling and sealing aluminum where soldering iron must be used and 500° F maximum allowable temperature. Good on thin sheets where distortion must be avoided. Melts at 400 F, flows at 450 F. Corrosion resistance, fair; good color match.

No. 39: Tin-zinc solder rods. For joining aluminum to dissimilar metals; resists corrosive action of salt water, atmosphere, etc. Used on aluminum castings, aluminum sheet and for joining aluminum to other dissimilar metals.

No. 41: Flux coated or bare brazing rod of copper, tin, iron and zinc, for joining ferrous and nonferrous metals, except aluminum. Joint properties Ts, 50,000 psi. For bronze castings, steel castings, copper, brass, and bronze parts such as propeller blades and impellers. Excellent color match on brass.

No. 53: Welding rod composed of lead, aluminum, copper and zinc. For joining die castings.

No. 61: Brazing rod of aluminum, magnesium, zinc, silicon and manganese. For joining magnesium parts. Low melting point and higher strength than base metal.

No. 100: Silver solder rods of silver, copper, zinc and nickel. Also sheets, strips and powders. For joining ferrous and nonferrous metals except aluminum and die castings. Properties of joint: Ts, 56,000 psi; resists corrosion by atmosphere and salt water. Used in fabrication of copper and steel parts, carbide tips, steel shanks, alloy steels, stainless steels, nickel alloys, etc.

No. 101: Silver solder of copper, silver, zinc and cadmium. Rods, sheets, strips and powders. For joining nonferrous and ferrous metals except aluminum and die castings. Joint properties: Ts, 52,000 psi; resists corrosion by atmosphere and salt water. Used in production of carbide tips, small assemblies, furnace brazing, piping systems, etc.

No. 111: Silver solder of copper, silver, zinc and cadmium. Rods, strips, sheets and powders. For joining ferrous and nonferrous metals except aluminum and die castings. Joint properties: Ts, 50,000 psi; resists corrosion by atmosphere and salt water. Thin flowing; high capillary action and affinity for ferrous and nonferrous metals. Used in producing carbide tips, small assemblies, furnace brazing and piping systems, etc.

No. 120: Silver solder of copper, silver, zinc and cadmium. Rods, sheets, strips and powders. For joining ferrous and nonferrous metals except aluminum and die castings. Joint properties: Ts, 75,000 psi; resists corrosion by atmosphere and salt water.

No. 252: Welding rod of Cr, Ni, Mn, Si and Fe. Ts, 95,000 psi; ys, 60,000 psi; bhn, 150-175; elong, 40%; resists corrosion by sulphur gases, acids and brines. For welding mild steel to stainless, stainless to stainless, low-alloy steels, low-alloy to high-alloy steels, and clad steels.

No. 299: An ac-dc rod. Ys, 90,000 psi; ts (as welded), 110-120,000 psi; elong, 20-25%; high temperature resistance. For use in vanadium-moly spring steels, nickel clad steels, tools and dies, medium carbon steels, etc.

Siltube No. 1: Silver brazing rod. Ag 40, balance Cu, Cd, Zn. Ts, 50,000 psi; shear str, 105,000 psi; melt pt, 1076 F. For copper, brass, steel, stainless steel, nickel, inconel, monel, and for dissimilar joints of these metals.

Phostube No. 4: Phosphor-copper brazing rod. Ts, 40,000 psi depending on joint design. Flows at 1300 F. Corrosion resistance high. For copper and copper alloys.

Silver Phostube: Silver bearing phosphor copper brazing rod. Ts, 50,000 psi depending on joint design. Flows at 1270 F; high corrosion resistance and capillary action; good matching color. For fabricating copper alloy parts in chemical, refrigeration, and electrical industries primarily.

ALLYMER (Allyl resin monomers)—Pittsburgh Plate Glass Co., Columbia Chemical Div., Barberton, O.

Complete line of allyl resin monomers formerly known as Columbia resins and designated as C. R. 39, etc. Numbers as 38 and 149 designate types. Compounds as Fiberglas base, allyl resin, allyl alcohol base resin, paper-base, allyl resin, cotton-cloth, allyl resin, for C.R. 39 and C.R. 149 types are available. Thermosetting; in sheets, rods, tubes and laminated form. Properties: Corrosion, heat and impact resistance; high tensile strength and low moisture absorp.

ALMET (Stainless steels) — Alloy Metal Wire Co., Inc., Prospect Park, Pa.

Standard stainless steels of AISI Types. For type numbers, characteristics and properties see "Stainless Steels" listing at end of this section.

ALNICO (Permanent magnet alloys)—Carboloy Co. Inc., Special Metals Div., Detroit 32, Mich.

High coercive force and high magnetic energy. Seven grades—Nos. 1, 2, 3, 4, 5, 6, and 12—each with different combinations of basic ingredients aluminum, nickel, and cobalt and different magnetic properties. All eight grades can be cast, but only Alnico 2, 4 and 5 are commercially available in sintered form. Sintered and cast Alnico furnished by General Electric and The Arnold Engrg. Co., Marengo, Ill., and Indiana Products Co., Chicago 2, Ill. Cast Alnico only furnished by the following: Simmons Saw & Steel Co., Fitchburg, Mass., Belden Mfg. Co., Chicago; Taylor Wharton Iron & Steel Co., High Bridge, N. J.; and Thomas & Skinner Steel Products Co., Indianapolis. Sintered Alnico only furnished by Stackpole Carbon Co., St. Marys, Pa.

ALPRO (Nonferrous alloys)—Alloys & Products Inc., New York 59.

More than 1000 nonferrous metal alloys of various compositions in shot, slab, ingots and miscellaneous forms.

AlSiMag (Ceramics) — American Lava Corp., Chattanooga 5, Tenn.

Ceramic parts of various grades and compositions custom made to individual requirements.

35 and 196: Steatite. High mechanical strength with low electrical losses at high frequency for use in most electrical and electronic applications.

243: Forsterite. Very low electrical losses at high frequency.

197: Steatite. High dielectric and mechanical strength, low dielectric leakage at elevated temperatures.

72 and 202: Cordierite. Resistant to heat shock for combustion tips and thermocouple insulators.

222: Refractory. Machined in the fired state.

192: Special hard. High polish for thread guides; resists corrosion except hydrofluoric acid.

393: Alumina refractory. Porous; electrical resistance at elevated temperatures, high.

491: Alumina. Dense; abrasion-resistant material especially suited for thread guides.

ALRAY (Electrical resistance alloys) — Alloy Metal Wire Co., Inc., Prospect Park, Pa.

A: Cr 20, Ni 80. Flat wire, rod and strip. For heating elements in electrical appliances and industrial heating equipment to meet most severe conditions of temperature and oxidation. Max cont serv temp, 2000 F; weldability, good.

C: Cr 15, Ni 62, balance Fe. For heating elements in electrical appliances and industrial heating equipment to meet most severe conditions of temperature and oxidation. Max cont serv temp, 1700 F.

D: Cr 18, Ni 35, balance Fe. For heating elements in electrical appliances and industrial heating equipment to meet most severe conditions of temperature and oxidation. Max cont serv temp, 1400 F.

ALTERNEX (Welding electrode) — Metal & Thermit Corp., New York 5.

All-position, ac or dc, straight polarity. Easy to use on light metal. Joint properties: Ts, 62-75,000 psi; elong in 2 in., 17-26%. AWS E6013.

ALUMINWELD (Welding electrode) — Lincoln Electric Co., Cleveland.

5% silicon-aluminum-alloy electrode for arc-welding aluminum in any form—cast, sheet, shapes, or extruded. For either metallic or carbon arc welding. Welds very dense without porosity and possesses high tensile strength.

AMBERLITE (Plastics resin adhesive) — Rohm & Haas Co., The Resinous Products Div., Philadelphia 5.

Phenolic resin adhesive in powder form. Moisture absorp, low; density, high. Used in manufacture of waterproof plywood for aircraft and marine use.

AMBRAC (Copper-nickel-zinc alloy) — American Brass Co., Waterbury, Conn.

Alloy 850; Cu 75, Zn 5, Ni 20. Sheet, wire, rods, and tubes. Corrosion resistance, high; ductility, high.

AMBRALOY (Copper-aluminum alloys)—American Brass Co., Waterbury, Conn.

Ambraloy 927: Cu 76, Zn 21.96, Al 2.0, As 0.04. For condenser tubes.

Ambraloy 901: Cu 95, Al 5. For condenser tubes.

AMERA-MAG (Steel)—American Tank & Fabricating Co., Cleveland, O.

Typical composition: C 0.11, Mn 1.10, P 0.11, Al 0.05, Si 0.05 max, Cu 0.10 max, Ni, Cr, Mo, 0.10 max each. Ingots, rough bars or billets, strip (coiled and straight), tubing, sheet and plate. Properties, unheat-treated: Ts, 70,000 psi; ys, 50,000 psi; elong in 2 in., 32%; imp str (Charpy), 15 ft-lb min at 50 F; machinability, good; weldability, good; max cont serv temp, approx 1500 F; abrasion resistance, medium. For applications requiring high heat and distortion resistance; also for applications involving temperatures down to —50 F.

AMERICAN (Bonded metals)—American Nickeloid Co., Peru, Ill.

Chromium, nickel, brass, copper, gold resemblance and colors bonded to base metals such as steel, zinc, brass, copper, aluminum and nickel silver. Available in brilliant finishes and patterns as sheets, flat strips, coiled strip and round edge flat wire. Can be supplied with gum-adhered paper covering protecting prefinish in drawing and preforming.

Copper steel: Copper plated to steel, serving as rust resistant, inexpensive metal. Available in polished and unpolished finishes in sheets, flat strips and coiled strip for continuous feed automatic presses.

AMERICAN Marine Genuine (Babbitt)—United American Metals Corp., Brooklyn 22, N. Y.

Bars. Properties, cold-worked: Ts, 8750 psi; comp str, 10,140 psi; ys, 8000 psi; elong in 2 in., 1.00%. For heavy-duty marine engines.

AMERICAN (Felt)—American Felt Co., Glenville, Conn.

Wool felt material to SAE specs in sheets, rods or tubes. For machining, stamping and extruding into parts. Abrasion resistance for certain felts, low, while for others, high; resists corrosion caused by neutral conditions; max cont serv temp, 250 F; flexibility, low, medium or high (as specified); moisture absorp, as specified; in any color. For oil retaining, dust excluding, filtering and vibration dampening.

AMERICAN (Plywood) — American Plywood Corp., New London, Wis.

Phenolic urea plywood sheets and laminates for machining into parts. Abrasion resistance, medium; max cont serv temp, 300 F; flexibility, high; ts, 12,000 psi; moisture absorp, medium; inflammable; shatterproof; opaque; can be highly polished.

AMERICAN (Steels)—American Steel Foundries, Newark 5, N. J.

HT: C 0.35-0.75, Ni 33.00-37.00, Cr 13.00-17.00. Special heat resisting steel.

HH: C 0.20-0.50, Ni 11.00-14.00, Cr 24.00-28.00. High heat resistant steel in sand castings to specification. Generally used for furnace parts.

CT-7M: C 0.07 max, Ni 34.00-37.00, Cr 13.00-17.00. Sand castings to specification. Properties, heat-treated: Ts, 65,000 psi; ys, 35,000 psi; elong in 2 in., 45%; bhn, 150. Resistant to hot sulphuric caustic solutions. For valves, fittings, pumps, etc.

CK-20: C 0.20 max, Ni 19.00-22.00, Cr 23.00-27.00. Sand castings to specification. Properties, heat-treated: Ts, 72,000 psi; ys, 33,000 psi; elong in 2 in., 25%; bhn, 170. Corrosion resistance, high.

CH-20: C 0.20 max, Ni 12.00-15.00, Cr 22.00-26.00. Sand castings to specification. Properties, heat-treated: Ts, 75,000 psi; ys, 35,000 psi; elong in 2 in., 25%; bhn, 160. Corrosion and heat resistant.

CF-7C: C 0.07 max, Ni 9.00-12.00, Cr 18.00-21.00. Sand castings to specification. Properties, heat-treated: Ts, 71,000 psi; ys, 32,000 psi; elong in 2 in., 45%; bhn, 150. Corrosion resistance, good. For valves, fittings and other parts used with welded construction.

CF-20: C 0.20 max, Ni 8.00-11.00, Cr 18.00-21.00. Steel castings to specification. Properties, heat-treated: Ts, 70,000 psi; ys, 30,000 psi; elong in 2 in., 40%; bhn, 155. Corrosion resistance, good.

CF-7M: C 0.07 max, Mo 1.75-3.00, Ni 9.00-12.00, Cr 18.00-21.00. Sand castings to specification. Properties, heat-treated: Ts, 72,000 psi; ys, 35,000 psi; elong in 2 in., 45%; bhn, 160; resistant to mine waters, sulphur dioxide, citric acid, etc. For valves, fittings, pumps, etc.

CF-7: C 0.07 max, Ni 8.00-11.00, Cr 18.00-21.00. Sand castings to specification. Properties, heat-treated: Ts, 70,000 psi; ys, 30,000 psi; elong in 2 in., 45%; bhn, 150. Resists lactic and acetic acids, salt brine, etc. For valves, fittings, pumps, etc.

CE-30: C 0.30 max, Ni 8.00-11.00, Cr 26.00-30.00. Sand castings to specification. Properties, heat-treated: Ts, 85,000 psi; ys, 45,000 psi; elong in 2 in., 15%; bhn, 170; corrosion resistance, good.

CB-30: C 0.30 max, Cr 18.00-22.00. Sand castings to specification. Properties, heat-treated: Ts, 90,000 psi; ys, 65,000 psi; elong in 2 in., 7%; bhn, 190; corrosion resistance, good. For valves and fittings.

CA-40: C 0.20-0.40, Si 1.00 max, Mn 0.85 max, Cr 11.50-14.00. Sand castings to specification. Corrosion resistance, good.

CA-15: C 0.15 max, Si 1.00 max, Mn 0.85 max, Cr 11.50-14.00. Sand castings to specification. Properties, heat-treated: Ts, 90,000 psi; ys, 65,000 psi; elong in 2 in., 18%; bhn, 220. Corrosion resistance, good. Generally used for parts in chemical apparatus.

Type 31: C 0.20-0.30, Si 0.60 max, Ni 2.50-3.00, Mn 0.70-1.00, Mo 0.20-0.40, Cr 1.00-1.50. Sand castings to specification. Properties, heat-treated: Ts, 150,000 psi; ys, 135,000 psi; elong in 2 in., 10%; bhn, 300. For structural and aircraft parts requiring high strength and toughness.

Type 23: C 0.25-0.35, Si 0.60 max, Mn 0.60-0.80, Ni 1.00-1.50, Cr 0.50-0.80. Sand castings to specification. Properties, heat-treated: Ts, 99,000 psi; ys, 57,000 psi; elong in 2 in., 22%; bhn, 200.

Type 22: C 0.15-0.30, Si 0.60 max, Mn 0.60-0.80, Mo 0.40-0.65, Cr 4.50-6.50. Sand castings to specification. Properties, heat-treated: Ts, 100,000 psi; ys, 65,000 psi; elong in 2 in., 18%; bhn, 250 max. For high-temperature steam or oil service.

Type 20: C 0.25-0.35, Si 0.60 max, Mn 0.60-0.80, Mo 0.40-0.60, Cr 0.60-0.80. Sand castings to specification. Properties, heat-treated: Ts, 100,000 psi; ys, 70,000 psi; elong in 2 in., 22%; bhn, 200. For welded construction and for highly stressed parts.

Type 12: C 0.10-0.20, Si 0.60 max, Mn 0.60-0.80, Ni 2.50-3.00. Sand castings to specification. Properties, heat-treated: Ts, 70,000 psi; ys, 40,000 psi; elong in 2 in., 26%. High impact values at low temperatures.

Type 10: C 0.15-0.25, Si 0.60 max, Mn 0.60-0.80, Mo 0.40-0.60. Sand castings to specification. Properties, heat-treated: Ts, 65,000 psi; ys 35,000 psi; elong in 2 in., 20%; bhn, 160. For high-temperature service.

Hylastic: C 0.26-0.36, Mn 1.40-1.70, Si 0.60 max. Sand castings to specification. Properties, heat-treated: Ts, 90,000 psi; ys, 60,000 psi; elong in 2 in., 22%; bhn, 180. For structural castings.

A-20: C 0.07 max, Cr 18.0-22.0, Ni 20.0-30.0, others, Mo and Cu. Sand castings to specification. Properties, heat-treated: Ts, 65,000 psi; ys, 30,000 psi; elong in 2 in., 30-40%; bhn, 130-150. Corrosion resistance, good. For valves and fittings in sulfuric acid service.

Type 1: C 0.20-0.30, Si 0.60 max, Mn 0.60-0.80, P 0.05 max, S 0.06 max. Sand castings to specification. Properties, heat-treated: Ts, 70,000 psi; ys, 38,000 psi; elong in 2 in., 24%; machinability, good; weldability, good.

AMEROID (Casein thermoplastic) — American Plastics Corp., New York 1.

Rods or sheets for machining. Abrasion resistance, medium; resistant to weak acids and organic solvents; softens when exposed to weak alkalies; decomposes when exposed to strong acids or alkalies. Max cont serv temp, 150 F; flex str, 10,000-18,000 psi; dielectric str, 400-700 (volts per mil inst); ts, 10,000 psi; comp str, 27-53,000 psi; impact str (Izod), 1.0 ft lb; in colors; moisture absorp, medium; sp gr, 1.34; translucent and opaque; machinability, good; bhn 23. For bushings, knobs, etc.

AMMONODUCT (Butt-welded steel pipe)—Bethlehem Steel Co., Bethlehem, Pa.

Cold bending, butt-welded steel pipe for refrigeration purposes.

AMPCOLOY (Copper-base alloys) — Ampco Metal Inc., Milwaukee 46.

Grade A-3: Cu 89, Al 10, Fe 1. Sand and centrifugal castings, rods and bars. Corrosion-resistance, good; ts, 70,000 psi; ys, 26,000; bhn (3000-kg), 115; abrasion resistance, fair; high ductility; nonmagnetic; good bearing properties; can be forged and welded. For bushings, bearings and pickling equipment.

Grade E-1: Analysis similar to A-3. Sand and centrifugal castings. Corrosion - resistance, good; ts, 75,000 psi; ys, 30,000 psi; bhn (3000-kg), 140; abrasion resistance, fair; ductility, fair; nonmagnetic; bearing properties, fair. For bearings, bushings, gears and pickling equipment.

Grade E-123; heat-treated, to E-1 analysis above. Furnished as sand or centrifugal castings, rods and bars. Corrosion-resistant. Ts, 80,000 psi; ys, 40,000 psi; bhn, (3000-kg), 145; high ductility; good abrasion resistance; nonmagnetic; excellent bearing properties. For bushings, bearings, gears, sleeves; also steel mill screw-down nuts; can be forged and welded.

Grade E-117: Analysis similar to A-3. Heat-treated sand and centrifugal castings. Corrosion resistance, good; ts, 90,000 psi; ys, 66,000 psi; bhn (3000-kg), 225; abrasion resistance, good; nonmagnetic; can be welded and forged.

Grade 46-22: Al 10.5, Fe 5, Ni 5, Cu balance. Sand and centrifugal castings. Heat-treated properties: Ts, 110,000 psi; ys, 60,000 psi; elong, 10%; reduction of area, 8%; bhn (3000-kg), 217-348; can be forged and welded. For use where strength with ductility is required.

Grades 62, 64, and 66: Series of low, medium and high-strength manganese bronzes. Sand and centrifugal castings. Ts, 65-110,000 psi; ys, 30-65,000 psi; bhn (3000-kg), 115-215; can be forged and welded. For structural parts not requiring best bearing characteristics.

Grade 86-20: Beryllium-copper. Be 2.5, Ni 1.2, Cu balance. Sand and centrifugal castings. Heat-treated properties: Ts, 100,000 psi; ys, 90,000 psi; bhn (3000-kg), 350. For welding dies and safety tools.

Grade 44: Centrifugal castings, rough bars, billets and wire. Unheat-treated properties: Ts, 70,000 psi; ys, 35,000 psi; elong in 2 in., 2%; bhn (3000-kg), 185. For welding dies, electrode holders, flash and butt welding jaws, etc.

Grade 45-22: Al 10, Fe 3, Ni 5, Mn 1, Cu balance. Forgings and finished rods and bars. Heat treated properties: Ts, 105,000 psi; ys, 55,000 psi; elong in 2 in., 10%; bhn (3000-kg), 200; nonmagnetic; weldability, good; resists weak acids. For gears, bearings, shafts, etc.

Grade 49: Al 7, Fe 1, Mn 1, Cu balance. Finished rods, bars and tubing. No heat treatment required. Ts, 75-90,000 psi; ys, 37-45,000 psi; elong in 2 in., 15-30%; bhn, 150-175. Nonmagnetic; machinability, good; weldability, good; resistant to many types of corrosion; abrasion resistance, high. Excellent cold heading bar and wire material for springs, bolts, nuts, rivets; also heat exchanger tubes.

Grade 50: Cu 84, Sn 10, Pb 2.5, Ni 3.5. Rough bars or billets, sand and centrifugal castings. Unheat-treated properties: Ts, 40,000 psi; ys, 22,000 psi; elong in 2 in., 15%; bhn (500-kg), 80; nonmagnetic; weldability, poor; abrasion resistance, medium. For worm gears where speeds are high with light to moderate loads.

Grade 71: Cu 88.5, Sn 6, Pb 1.5, Zn 4. Rough bars or billets, and sand and centrifugal castings. Unheat-treated properties: Ts, 34,000 psi; ys, 16,000 psi; elong in 2 in., 22%; bhn (500-kg), 60; nonmagnetic. For pressure castings, gears, bushings, bearings, etc.

Grade 72: Cu 88, Sn 8, Zn 4. Rough bars or billets, and sand and centrifugal castings. Unheat-treated properties: Ts, 40,000 psi; ys, 20,000 psi; elong in 2 in., 20%; bhn (500-kg), 60; nonmagnetic; weldability, fair. For bushings, bearings, etc.

Grade 74: Cu 85, Sn 5, Pb 5, Zn 5 (Ounce metal). Rough bars or billets, sand, permanent-mold, and centrifugal castings. Unheat-treated properties: Ts, 30,000 psi; ys, 18,000 psi; elong in 2 in., 20%; bhn (500-kg), 55; nonmagnetic; weldability, fair. For valves, pipe elbows, etc., (applications up to 350 lbs.).

Grade 79: Cu 88, Sn 10, Zn 2. Rough bars or billets, and sand and centrifugal castings. Unheat-treated properties: Ts, 40,000 psi; ys, 20,000 psi; elong in 2 in., 16%; Rock hdns, F70; nonmagnetic; weldability, fair; abrasion resistance, medium. For bushings, bearings, gears, etc.

AMPCO METAL (Copper-base alloys)—Ampco Metal, Inc., Milwaukee 46.

Grade 8: Al 7.0, Fe 2.5, Cu balance. Straight and coiled strip, sheet and plate. Ts, 90-100,000 psi; ys, 45-60,000 psi; elong in 2 in., 25-30%; bhn (3000-kg), 150-190; machinability, good; weldability, good; corrosion and scaling resistance, excellent; abrasion resistance, high. For gib liners, wear strip and corrosion and wear-resistant parts.

Grade 12: Al 9.0, Fe 3.0, Cu balance. Sand and centrifugal castings. Corrosion resistance, good; ts, 70,000 psi; ys, 28,000 psi; comp str, 120,000 psi; sp gr, 7.73; bhn (3000-kg), 115; elong in 2 in., 25%; abrasion resistance, good; nonmagnetic; machinability, good; can be forged and welded. For bushings and bearings.

Grade 15: Al 9.5, Fe 3.5, Cu balance. Solid and hollow rods and bars. Corrosion resistance, good; ts, 85,000 psi; ys, 40,000 psi; sp gr, 7.62; bhn (3000-kg), 160; elong in 2 in., 25%; abrasion resistance, good; nonmagnetic; good surface finish; good bearing qualities. For bushings, bearings, small worm wheels, bolts, nuts, and studs.

Grade 16: Al 10.0, Fe 3.5, Cu balance. Sand and centrifugal castings. Corrosion resistance, good; ts, 85,000 psi; ys, 32,000 psi; comp str, 125,000 psi; sp gr, 7.62; bhn (3000-kg), 140; elong in 2 in., 20%; abrasion resistance, good; nonmagnetic; machinability, good; can be forged and welded. For bushings, bearings, gears, slides and shifter forks.

Grade 18: Al 11.0, Fe 3.5, Cu, balance. Sand and centrifugal castings; also extruded rods, bars and forgings. Corrosion resistance, good; ts, 85,000 psi; ys, 35,000 psi; comp str, 136,000 psi; sp gr, 7.58; bhn (3000-kg), 170; elong in 2 in., 16%; abrasion resistance, good; nonmagnetic; machinability, fair. For heavy-duty bushings, bearings, gears, worm wheels, feed nuts and pickling equipment.

Grade 18-13: Al 11.0, Fe 3.5, Cu balance. Rough bars, sand, centrifugal, and permanent-mold castings. Heat treated properties: Ts, 80,000 psi; ys, 32,000; elong in 2 in., 16%; bhn (3000-kg), 150; nonmagnetic. Uses similar to Grade 18.

Grade 18-22: Al 11.0, Fe 3.5, Cu balance. Rough bars, sand, centrifugal, and permanent-mold castings. Heat treated properties: Ts, 95,000 psi; ys, 50,000 psi; elong in 2 in., 4%; bhn (3000-kg), 212; nonmagnetic; weldability, good; corrosion and abrasion resistance, high. For bearings, guides, wear strips, etc.

Grade 18-23: Heat-treated version of Grade 18. Sand and centrifugal castings, rods and bars. Corrosion resistance, good; ts, 95,000 psi; ys, 45,000; comp str, 150,000; sp gr, 7.60; bhn (3000-kg), 190; elong in 2 in., 14%; abrasion resistance, good; nonmagnetic. Used where high strength, good bearing properties and wear or corrosion resistance is required. Ideal for heavy-duty worm gears.

Grade 20: Al 11.5, Fe 4.0, Cu balance. Sand and centrifugal castings, rods and bars. Corrosion resistance, good; ts, 85,000 psi; ys, 38,000 psi; comp str, 146,000 psi; sp gr, 7.43; bhn (3000-kg), 230; abrasion resistance, high; nonmagnetic. For cams, cam rollers, welding jaws, bushings and bearings.

Grade 21: Al 13.0, Fe 4.5, Cu balance. Sand and centrifugal castings, rods and bars. Corrosion resistance, good; ts, 75,000 psi; ys, 45,000 psi; comp str, 160,000 psi; sp gr, 7.14; bhn (3000-kg), 300; abrasion resistance, high; nonmagnetic. Used in drawing and forming dies, bushings and liners, replacing steel.

Grade 22: Al 14.0, Fe 4.5, Cu balance. Sand and centrifugal castings, rods and bars. Corrosion resistance, good; ts, 75,000 psi; ys, 60,000; comp str, 171,000 psi; sp gr, 7.21; bhn (3000-kg), 330; abrasion resistance, high; nonmagnetic; can be forged and welded. For cam rollers, wear strips, forming and drawing dies.

Grade 24: Special aluminum bronze as sand and centrifugal castings. Produced especially for long-run service as drawing and forming die material. Wear resistance, good; will not scratch or gall. For drawing dies, forming rolls, extrusion punches, spinning tools, etc.

AMPCO-TRODE (Coated aluminum-bronze welding rods)—Ampco Metal, Inc., Milwaukee 46.

Grade 10 and 10AC: General-purpose, coated aluminum-bronze electrode for metal and carbon-arc welding of brasses, aluminum bronzes, silicon bronzes, cast and malleable iron, nickel - alloys and dissimilar metals where high strength, ductile, corrosion-resistant welds are required. Bhn (3000-kg), 119. Recommended for overlaying bearing

and wear-resisting surfaces.

Grade 160 and 160AC: Coated aluminum-bronze electrode producing deposit of high strength and good ductility with average bhn of 160 (3000-kg). Applied by either metal or carbon-arc methods. For joining aluminum bronzes of similar composition; also for welding ferrous or nonferrous fabrications and dissimilar metals.

Grade 200 and 200AC: Coated aluminum-bronze electrode for metal or carbon-arc methods. Deposits average bhn 200 (3000-kg) and give high strength and hardness combined with good ductility. Primarily an overlay electrode but recommended for joining aluminum bronzes of similar composition. Corrosion resistance, good. For overlaying bearings requiring wear resisting characteristics.

Grade 250 and 250AC: Coated aluminum-bronze electrode. For metal or carbon-arc methods. Yield strength, high; bhn, 250 (3000-kg); corrosion resistance, good; deposit adaptable for use in extreme bearing applications where very high pressures are encountered operating against hard steel surfaces; where unusual wear-resistant qualities are required to increase service life of wearing parts. Recommended for joining aluminum bronzes of similar composition.

Grade 300 and 300AC: Coated aluminum-bronze electrode. For metal or carbon-arc methods. Yield strength, exceptional; bhn, (3000-kg), 300. Excellent bearing and wear-resistant qualities. Recommended for fabricating new or rebuilding worn ferrous dies, and for forming or drawing low-carbon or stainless steel.

AMSCO (Alloy steel castings)—American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

Manganese steel castings: C 1-1.4, Mn 10-14, Si 0.2-1.0, P 0.10 max. Ts (heat-treated), 100-145,000 psi; ys, 50-57,000 psi; elong in 2 in., 30-60%; reduction in area, 30-40%; bhn, 185-210 (work hardens up to bhn 550); magnetic permeability, 1.003-1.10; weldability, good; max cont serv temp, 500 F; abrasion resistance, medium. Superior for heavy impact applications. Retains toughness at subzero temperatures. For crusher parts, grinding mill liners, power shovel dippers and parts, dredge buckets, material handling pumps, trackwork frogs and crossings, conveyor chains, wire rope sheaves, gears, wheels, etc.

Chromium-Molybdenum steel castings: C 0.5-1.0, Mn 0.5-1.5, Si 0.2-0.8, Cr 1.8-2.8, Mo 0.2-0.5. Ts (heat-treated), 120-200,000 psi; ys, 90-158,000 psi; elong in 2 in., 2-11%; reduction in area, 4-20%; bhn, 300-350. Physical properties adjusted to meet service requirements. Abrasion resistance, high. Impact resistance, medium. For grinding mill liners, grates, etc.

AMSCO (Welding rods and electrodes)—American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

Air-Hardening: C 1.0-1.5, Cr 2.0, Mo 1.0. Bhn, 450-550. Abrasion and impact resistant up to 400 F; martensitic, air-hardening steels.

Nickel-Manganese steel: C 0.8, Mn 14.0, Ni 4.0. Bhn, 200 (work hardens up to 500 bhn). Extremely impact resistant and abrasion resistant from —100 F to 500 F. Austenitic deposits; nonmagnetic. For rebuilding manganese steel frogs, crossings, dippers, dipper teeth repointers. Also quarrying, logging, oil, construction, mining, steel mill and excavating equipment wearing parts.

No. 1: C 2.5, Cr 31.0, Co 43.0 min, W 12.5, Bhn, 500-540. Abrasion resistant up to 1200 F and higher. Resists acids, bases and salts; high creep strength; solid solution and eutectiform matrix anchoring very hard crystals of complex carbides. High resistance to liquid and hot gas corrosion. For hard facing wire guides, pump sleeves, carbon scrapers, mandrels, lathe and grinder centers, etc.

No. 6: C 1.0, Cr 28.0, Co 55.0 min, W 4.5. Bhn, 400-500. Abrasion and impact resistant up to 1200 F and higher. For hard-facing to serve at elevated temperatures. Resists acids, bases and salts; high creep strength, stainless solid solution matrix containing complex scattered eutectic carbides. High resistance to liquid and hot gas corrosion. For hard facing high-pressure, high-temperature steam valves, hot trimming dies, shear blades, exhaust valves, valve seats, locomotive valve gears, etc.

No. 217: C 3.0, Cr 8.0, W 15.0. Bhn, 600-700. Abrasion resistant up to 1000 F. For hard-facing only. Martensitic iron deposits, slightly magnetic, extremely abrasion resistant. For hard facing machine parts subject to extreme abrasion at normal and elevated temperatures up to 1000 F, such as conveyor screws, muller plows, coke pusher shoes, pickup shoes, rolling mill guides, carbon scrapers, pinch rolls, etc.

No. 459: C 3.0, Cr 4.0, Mo 4.0. Bhn, 500-600. Abrasion resistant up to 800 F. For hard-facing only. Martensitic iron deposits; slightly magnetic; abrasion resistance, high; mild impact. For hard facing machine parts, subject to extreme abrasion and mild impact such as pug mill knives, mixer blades, brick dies, pulverizer hammers, muller tires, rolling mill guides, hog anvils, car retarder beams and parts, etc.

ANACONDA (Copper-base alloys) — American Brass Co., Waterbury, Conn.

"85" Red Brass: Cu 85, Zn 15. Pipe, tube and sheet. Particularly resistant to salt water corrosion.

Super-Nickel: Cu 69.6, Ni 30, Fe 0.4. Seamless tubes, sheets and plates. For severe condenser tube service and where resistance to salt water corrosion is desired.

Free-cutting phosphor bronze: Cu 88, Sn 4, Zn 4, Pb 4. Corrosion, heat and abrasion-resistant; combines general characteristics of standard phosphor bronze alloys with free-cutting qualities of yellow brass.

ANACONDA CUPRO-NICKEL 754 (Copper-nickel alloy)—American Brass Co., Waterbury, Conn.

Seamless condenser tubes, rolled plates and tube sheets. Weight, 0.323 lb per cu in.; thermal conductivity, 314 btu/sq ft/inch/hr/°F at 68 F; coef exp'n (average per °F from 77-572 F), 0.0000093.

ANCHOR CARBON-VANADIUM (Drill rod) — Anchor Drawn Steel Co., Latrobe, Pa.

Drill rods for use where toughness is required and minimum machining is necessary. Hardens with fine-grained tough case, and resists breakage. For pins, bushings, punches, dies, etc.

ANFRILOY (Bearing bronze)—Wellman Bronze & Aluminum Co., Cleveland.

Copper-lead-tin bearing bronze for high-speed, light-duty bearings and for bushings where pressure and thrust are not excessive.

APEX (Nonferrous die casting alloys) — Apex Smelting Co., Chicago 12.

Aluminum, zinc and magnesium-base die casting alloys in slab, ingot, shot, and piglet form.

APOLLO (Prefinished cold-rolled steel)—Apollo Metal Works, Chicago 38.

Chromsteel: Cold-rolled strip, nickel-chrome-plated steel. Sheets and strips for stamping into parts. Resists heat to 800 F; abrasion resistance, medium; weldability, fair. Used to make chrome finished parts and items that need no plating or polishing after stamping. For heat and light reflectors, toasters, hot plates, moulding, plastic inlays, fan blades, chocolate moulds, etc.

APW (Silver brazing alloys) — The American Platinum Works, Newark, N. J.

Various silver brazing alloys with melting points from 1134 F. For low-temperature bonding of ferrous and nonferrous metals. Wires, strips, rings and filings. Also APW fluxes for use with silver brazing alloys.

APW fine, sterling and coin silver sheet, wire, rods, blanks, circles, seamless tubing, fine silver anodes, gauze, foil and special apparatus.

APW platinum metals and alloys, plate, foil, wire tubing and special apparatus.

ARCALOY (Welding electrodes) — Alloy Rods Co., York, Pa.

Electrodes for welding stainless steels.

ARC-CRAFT (Arc welding electrodes) — Allied Weld-Craft, Inc., Indianapolis 4, Ind.

Twelve types of mild steel electrodes ranging through AWS Specs. E6010 to E9016. For joining mild steels and low alloys.

ARCOS (Stainless steel arc welding electrodes) —Arcos Corp., Philadelphia 43, Pa.

Stainless steel and alloy arc-welding electrodes.

ARISTOLOY (Alloy steels) — Copperweld Steel Co., Warren, O.

Standard alloy steels in ingot, rough bars or billets, finished rods and bars.

ARMACAST (Alloy steel castings)—Union Steel Castings Div., Blaw-Knox Co., Pittsburgh 1.

C 0.30, Mn 0.60-0.90, Si 0.35, Cr 2.65-3.15, Mo 0.50, P 0.05 max, and S 0.05 max. Sand castings to specification. Properties, water-quenched and drawn: Ts, 110,000 psi min.; ys, 75,000 psi min.; elong in 2 in., 25%; impact str (Charpy), 50 ft-lb min. at room temp; bhn, 240-260; magnetic; machinability, good; weldability, good; abrasion resistance, high. Used in applications where extraordinary strength, toughness or hardness is required. Heat treated to meet various physical requirements.

ARMATITE (Composite slot insulation)—Mica Insulator Co., Schenectady, N. Y.

Strong, flexible two-in-one insulation furnished in two combinations: Straight-cut yellow varnished cambric combined with nshpaper; Bias-cut yellow varnished cambric combined with 100% ragpaper. The paper provides mechanical protection and the cambric furnishes the dielectric strength. For armature and stator slot cell insulation.

ARMCO (Steels)—Armco Steel Corp., Middletown, Ohio.

Stainless steels in standard forms to AISI specs. For data on types, properties and characteristics see "Stainless Steels" listing at end of this section.

Tran-Cor X, 2X, 3X: Oriented electrical steel with superior magnetic properties in the direction of rolling. For highest efficiency transformers.

Radio 5 and 6: Special steel for audio transformers where high inductance at low magnetic density is required.

Tran-Cor 52, 58 and 65: For cores of high efficiency power and distributing transformers.

Tran-Cor 72: For cores of power and distributing transformers where highest efficiency is not required.

Intermediate Transformer: For cores of industrial transformers in intermittent use; radio transformers.

Special Electric: For alternating current motors and generators in industrial service.

Electric: For domestic electric appliance motors.

Thin Gage Electrical Steel: In gages down to 0.001-in. for high frequency applications.

Magnetic Ingot Iron: Low-carbon, low-impurity iron specially processed for high magnetic properties; for cores of dc electrical and magnetic equipment. Rough bars and billets, finished rods and bars, sheet, strip and plate.

Aluminized Steel: Aluminum-coated sheet or strip with outstanding heat resistance and heat reflectivity.

Cold Rolled Paintgrip (Bonderized cold-rolled sheet): Iron or steel sheets or coils mill-treated with electrolytic "flash" of zinc and then Bonderized. Eliminates Bonderizing after fabrication. Draws, forms, welds and solders easily.

Zincgrip: Special zinc-coated sheet that does not peel in forming or drawing. Can be supplied in coils, and also mill-bonderized (Zincgrip-Paintgrip) for immediate painting with no pretreatment required. Base metal can be Ingot Iron, copper-bearing steel or mild steel.

Galvanized: Zinc-coated sheet available in Ingot Iron, copper-bearing steel or mild steel base metal.

Enameling Iron: Low-carbon, low-impurity iron processed specially for porcelain enameling. Less than 0.10% of C, Mn, P, S, Si.

Long Ternes: Sheets or coils supplied with lead-tin alloy coating. Excellent for soldering; also deep drawing. Used for caskets, gasoline tanks and other automotive parts. Available in Ingot Iron, copper-bearing steel and mild steel.

Hot and cold-rolled sheet and strip: Straight lengths and coils; obtainable in Ingot Iron, copper-bearing steel and varying analyses of medium and low-carbon steel. For severe deep drawing requirements.

Mechanical Electric Welded Tubing: Electric resistance welded from steel strip to close dimensional tolerances. From ⅜ to 3-in. O.D., 22 to 13 gage. Zincgrip and Aluminized steel tubing also available.

Armco 17-14 Cu-Mo Stainless Steel: Bars, sheets, strip, wire, and plate. Exceptional stress-rupture and creep properties at elevated temperatures up to 1500 F. For parts requiring high strength at high temperatures.

Armco 17-4 PH Stainless Steel: Chromium-nickel-copper stainless grade with corrosion resistance generally comparable to 18-8; but hardenable by low-temperature (900 F) heat treatment to Rock C40-45. Bar and wire. Hardened condition properties: Ts, 190-215,000 psi; ys, 170,000-200,000 psi; elongation in 2 in., 6-12%.

Armco 17-7 PH Stainless Steel: Chromium-nickel-aluminum stainless grade with corrosion resistance comparable to 18-8; but with strength and elastic properties equal to best high carbon spring steels. Highest strength and hardness (Rockwell C50 and higher) developed by 850-900 F heat treatment. Where severe forming or deep drawing is involved it can be furnished in soft temper with high strength and hardness

(Rockwell C40-45) developed by treatment at 1400 F and 900 F. Sheet, strip and wire.

Armco Type 304 ELC, 316 ELC and 317 ELC Stainless Steel: Chromium-nickel stainless grades comparable to standard 18-8 and 18-10 Mo grades but fully resistant to sensitizing effects developed by welding. Carbon content 0.03% max. Not suitable for extended service in carbide precipitation range of 800 to 1650 F when corrosive conditions are severe. Sheet, strip, plates, bar and wire.

ARMORPLY (Plywood)—United States Plywood Corp., New York.

Metal covered sheets. High strength and low weight. For use in food machinery, laboratories, etc.

ARMSTRONG'S (Compositions of cork, rubber, cork-and-rubber, fiber, and felt paper)—Armstrong Cork Co., Lancaster, Pa.

Compositions of cork and Neoprene, Buna N, Buna S, Thiokol, and butyl rubber. More than two dozen materials having a wide range of physical properties. Roll, sheet, cut gasket, and extruded forms. Impervious to liquids and gases; highly resistant to deterioration by oils, solvents and most other liquids, gases, corona and weather; coef friction, compr, lateral flow, etc., to meet requirements. Available with or without fabric backing or adhesive coating. Furnished to meet specific requirements. Used as gaskets, packings, washers, valve disks, feed rolls, polishing wheels, diaphragms, friction and vibration pads, etc.

Compositions of cork and natural rubber, for specific applications not requiring the special characteristics of synthetic rubber.

Synthetic rubber compounds for applications where requirements include properties such as resistance to oil, aromatic fuel, solvents, sunlight or electrical corona—and where lateral flow is necessary or not objectionable.

Straight cork compositions, ranging in density from 8 lb to 36 lb per cu ft; compr, from 5 to 60%.

Rag felt papers for vibration damping, space packing, antisqueak lining and use as gaskets, dust seals, etc.

ARMSTRONG'S (Industrial adhesives) — Armstrong Cork Company, Lancaster, Pa.

Standard line includes rubber adhesives, latex adhesives, emulsions, resin adhesives, oleoresinous adhesives, asphaltic adhesives, and hot-melt adhesives. Many cements, pastes, emulsions, glues, mastics, and primers are available in brush, spray, gear-pump, or trowel consistency. Others may be applied by roll-coating, dipping, or doctor blade machine methods.

ASARCOLOY No. 7 (Cadmium-nickel bearing alloy)—American Smelting & Refining Co., New York.

Ni 1.3, Cd balance. Capable of withstanding high compression loads and high operating temperatures. Ingots for spinning and permanent-mold castings. Max cont serv temp, 300 F; abrasion resistance, high; ts, 15,000 psi; compr str, 20,000 psi; sp gr, 8.7 psi; bearing properties, good; weldability, good. Used for bearings.

ATHENIA (High carbon steel)—The Athenia Steel Co., Div. of National Standard Co., Clifton, N. J.

Cold-rolled, high-carbon flat steels in widths of 1/16-in. to 6½ in.; thickness, 0.0015 to 0.062-in. Custom-made steels of 0.60 carbon and higher. Entire range of annealed, hard-rolled, black-tempered, tempered and polished or tempered and polished with blue or straw-colored finish.

ATLAS No. 93 (Oil-hardening steel)—Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

C 0.55, Cr 0.70, Mo 0.40. For collets, studs and parts requiring toughness in hardened condition. Oil hardening. For use as bucket teeth, keys, pins, bolts, studs, etc.

AUR-O-MET (Aluminum bronzes)—Aurora Metal Co., Aurora, Ill.

Alloy No. 11B: Cu 88.5, Al 10.5, Fe 1. Die castings to specification. Ts, 85,000 psi; ys, 40,000 psi; elong in 2 in., 20%; Rock hdns, B81; sp gr, 7.4; machinability, fair; weldability, fair; resists corrosion caused by weak acids, brines and organic solvents; max cont serv temp, 650 F; abrasion resistance, medium. Used for gears, pumps, gibs, brackets, nuts, bearings and structural parts.

Alloy No. 11: Cu 89, Al 9.8, Fe 1. Die castings to specification. Ts, 75,000 psi; ys, 30,000 psi; elong in 2 in., 30%; Rock hdns, B68-70; sp gr, 7.4; nonmagnetic; machinability, fair; weldability, fair; resists corrosion caused by weak acids, brines and organic solvents. Max cont serv temp, 650 F; abrasion resistance, medium. Used for gears, pumps, gibs, brackets, nuts, bearings and structural parts.

Alloy No. 56: Cu 80.5, Al 10.5, Fe 4.25, Ni 4.75. Vacuum die castings to specification. Ts, 95,000 psi; ys, 65,000 psi; elong in 2 in., 5-10%; Rock hdns, B90; sp gr, 7.4; machinability, fair; weldability, fair; resists corrosion caused by weak acids, brines and organic solvents; max cont serv temp, 650F; abrasion resistance, medium. Used for gears, pumps, gibs, brackets, nuts, bearings and structural parts.

Alloy No. 57: Cu 76, Al 12, Fe 5 and Ni 7. Vacuum die castings to specification. Ts, 115,000 psi; ys, 85,000 psi; elong in 2 in., 0.5%; Rock hdns, C 30; sp gr, 7.4; machinability, fair; weldability, fair; resists corrosion caused by weak acids, brines and organic solvents; max cont serv temp, 650 F; abrasion resistance, medium. Used for pumps, wear plates, etc.

AUSTENAL (Investment castings) — Austenal Laboratories, Inc., New York and Chicago.

Precision investment castings having close tolerances, soundness and smooth surfaces Microcast in high-temperature alloys, low alloys, carbon steels, stainless and tool steels.

AUTOLUBE (Powder-metal parts)—International Powder Metallurgy Co., Ridgeway, Pa.

Cu-Sn powder-metal in parts to specification. Cu 90, Sn 10, graphite 0.5. Properties of 6.2-density material: Ts, 14,000 psi; ys, 11,000 psi; bhn, 32; abrasion resistance, low. Properties of 6.5-density material: Ts, 16,000 psi; ys, 15,000 psi; bhn, 36. Properties of 6.7-density material: Ts, 18,000 psi; ys, 16,000 psi; bhn, 37. Excellent for bearings, bushings, and similar parts.

AVIALITE (Copper-aluminum alloy)—American Brass Co., Waterbury, Conn.

For valve seats and guides in airplane motors.

"AW" DYNALLOY (Alloy steel)—Alan Wood Steel Co., Conshohocken, Pa.

Rough bars, sheets, and plates for welding, cold forming, hot forming, stamping, etc. Abrasion resistance, high; ts, 65-80,000 psi; ys, 50,000 psi; elong in 2 in., 25%; endurance limit (completely reversed bending), 45,000 psi; weldability, good. For welded structures requiring high strength, such as machine bases and tanks.

AZTEC (Asbestos packing)—Gatke Corp., Chicago 1.

Packing for high-pressure valve stems, rods and other machine elements. Compressed sheet, oilproof plastics, twisted and braided stock and wire-interwoven sheet.

B-50 (Powder metal)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

High copper content; pressed and sintered parts to specification; imp str (Izod) 2 ft-lb; Rock hdns, H 60; abrasion resistance, medium; for bushings, bearings, etc.

BAKELITE (Plastics)—Bakelite Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17.

Phenolic plastics, general-purpose; Thermosetting; granular form for molding; corrosion-resistant; dielectric str at 60 cycles, 270-350 volts per mil inst; nonflammable; ts, 6500-9000 psi; low thermal conductivity; available in dark colors; takes high polish; low moisture absorp.

Phenolic plastics, mineral filled: Similar to foregoing. High heat resistance, low moisture absorp; nonflammable.

Phenolic, fabric and mineral-filled. Similar to general-purpose phenolic plastics but much better in impact resistance; impact strength (Izod) .50-4.0 ft-lb per inch of notch. For gears, bushings, bearings and heavy-duty parts.

Polyethylene: Thermoplastic. Good resistance to softening by higher temperatures than any similar material previously produced. Outstanding characteristic is unusually good electrical properties. Extremely low coefficient of moisture absorp and water vapor transmission; resists effects of practically all chemicals; inherently flexible; can be produced as molded or extruded goods, sheet materials, film, or any of other usual forms of plastic materials.

Polystyrene plastics: Thermoplastic. Granular form for molding; transparent, translucent and opaque effects, in all colors; takes high polish; low moisture absorp; sp gr, 1.05-1.07; dielectric str at 60 cycles, 500-525 volts per mil inst; volume resistivity, 10 deg megohm centimeters; power factor, 0.0002-0.0003 from 60 cycles to 50,000,000 cycles; exceptional resistance to acids and alkalies.

BAKER (Precious metals)—Baker & Co. Inc., Newark 5, N. J.

Platinum and alloys for linings, contacts, thermocouples, furnace resistors, etc.

BAKER CASTING RESIN (Plastic resin)—Baker Oil Tools, Inc., Los Angeles 54.

Phenol formaldehyde thermosetting resin in liquid form for casting and laminating. Abrasion resistance, low; ts, 3-5000 psi; comp str, 8-12,000 psi; impact str (Izod), 1-3 ft-lb; natural and color concentrates; moisture absorp medium; sp gr, 1.2; transparent, translucent and opaque.

BAKER IMPREGNATING RESINS (Plastic resins)—Baker Oil Tools, Inc., Los Angeles 54.

Impregnating resin to seal porosity in metal castings.

BEARITE (Babbitt metal)—A. W. Cadman Mfg. Co., Pittsburgh.

Ingots and 50-lb pigs. Bhn at 70 F, 29.1; at 212 F, 24.4; comp str, 15,000 psi. For rotary bearings subjected to heavy loads and extreme speed.

BEARIUM METAL (High-lead bronze) — Bearium Metals Corp., Rochester, N. Y.

High lead bronze with specially prepared metallurgical structure providing good frictional properties.

Grade B-4: Cu 70, Sn 4, Pb 26. Rough-cored or solid bars, sand castings, machined bushings, and long rods for screw machine use. Ts, 21,000 psi; comp str, 9750 psi; bhn, 40. Abrasion resistance, high; low coefficient of friction; high ductility. Resists corrosion caused by acids. For bushings, bearings, packing, piston rings, and seals.

Grade B-8: Cu 70, Sn 8, Pb 22. Rough-cored or solid bars, rough castings, machined bushings, screw-machine rod stock. Ts, 25,000 psi; comp str, 11,500 psi; bhn, 50. Abrasion resistance, high; low coefficient of friction; high ductility. Resists corrosion caused by acids. Good bearing properties. For bearings, bushings, packing and piston rings, seals, cross-head shoes, etc.

Grade B-10: Cu 70.00, Sn 10.00, Pb 20.00. Rough-cored or solid bars, sand castings and machined bushings. Properties, unheat-treated: Ts, 25,500 psi; comp str, 11,800 psi; elong in 2 in., 10%; bhn, 55; machinability, good; abrasion resistance, high. Excellent bearing properties; nonseizing and nonscoring. For bushings, bearings, packing rings, piston rings and mechanical seals.

BEETLE (Urea-formaldehyde plastics)—Plastics Dept., American Cyanamid Co., New York 20.

Thermosetting: Powder or granules for molding purposes. Available in colors, translucent and opaque. Dielectric str, 300-350 (volts per mil inst); ts, 5000-7000 psi; comp str, 30-38,000 psi; flex str, 11-18,000 psi; shatterproof; moisture absorp, low; bhn, 78.9; nonflammable. For housings, cabinets, knobs, dials and insulators.

BELECTRIC (Special cast iron) — Belle City Malleable Iron Co., Racine, Wis.

Sand castings: Ts, 35-60,000 psi; compr str, high; bearing properties, good; recommended heat treatments are the same as for standard gray iron; bhn, untreated, 179-285; heat treated, 300-550. Used where rigidity, wearability, or where strong high grade gray iron might be applied.

BELECTROMAL (High-strength malleable iron)—Belle City Malleable Iron Co., Racine, Wis.

High-strength malleable iron: Sand castings. Ts, 60-70,000 psi; ductility, high; bhn, untreated, 140-170. Recommended for castings for automotive, railroad, tractor and implement work.

BELMALLOY (Pearlitic malleable iron)—Belle City Malleable Iron Co., Racine, Wis.

Electric furnace melted and continuous-oven annealed. Ts, 70,000 psi min; ys, 45,000 psi min; elong, 5% min; bhn, 179-217. For castings of machining quality requiring strength and shock resistance.

BENDIX (Flexible metal hose) — Metal Hose Dept., Bendix Aviation Corp., Teterboro, N. J.

Corrugated seamless tubing of various alloys. For exhausts, oil lines, vibration eliminators, etc.

BENELEX "70" (Wood-fiber panels)—Masonite Corp., Chicago.

Furnished ¼-2 in. thick; max cont serv temp, 150 F; dielectric str (volts per mil inst), 190; ts, 7700 psi; comp str, 26,500 psi; color, brown; shatterproof; sp gr, 1.41; opaque; machinability, good; Rock hdns, H90. For dies, fixtures and electrical equipment.

BERYLCO (Beryllium copper)—The Beryllium Corp., Reading, Pa.

Berylco 10: Be 0.4, Co 2.5, Cu balance. Rough bars or billets, finished rods or bars, straight and coiled strip. Properties, heat-treated: Ts 130,000 psi; comp str, 140,000 psi; ys, 90,000 psi; elong in 2 in., 8-12%; impact str (Izod), 3-5 ft-lb; endurance limit, 35,000 psi; Rock hdns, B90-100; sp gr, 8.7; nonmagnetic; machinability, fair; weldability, fair; resists corrosion caused by atmosphere, fresh and salt water, certain alkaline and acid solutions; max cont serv temp, 400 F; abrasion resistance, high; electrical and thermal conductivity, high. For springs and current carrying members.

Berylco 10C: Be 0.6, Co 2.5, Cu balance. Pig or ingot, sand, permanent-mold, and precision castings. Properties, heat-treated; Ts, 100,000 psi; ys, 80,000 psi; elong in 2 in., 8-12%; impact str (Izod), 10-15 ft-lb; Rock hdns, B90-95; sp gr, 8.7; nonmagnetic; machinability, fair; weldability, fair; resists corrosion caused by atmosphere, fresh and salt water, certain alkaline and acid solutions; max cont serv temp, 400 F; abrasion resistance, high; electrical and thermal conductivity, high. For circuit breaker and switchgear parts and similar electrical applications.

Berylco 20C: Be 2.0, Co 0.5, Cu balance. Pig or ingot, sand, permanent mold, and precision castings. Properties, heat-treated. Ts, 160,000 psi; ys, 135,000 psi; elong in 2 in., 2-5%; impact str (Izod), 5-8 ft-lb; Rock hdns, C37-43; sp gr, 8.25; nonmagnetic; machinability when heat treated, poor, when untreated, fair; weldability in untreated state, fair. Resists corrosion caused by atmosphere, fresh and salt water, certain alkaline and acid solution; max cont serv temp, 300 F; abrasion resistance, high; electrical and thermal conductivity, high. For plastic molds, safety tools, circuit breaker parts and other current carrying parts.

Berylco 25S: Be 2, Co 0.3, Cu balance. Rough bars or billets, finished rods or bars, straight and coiled strip, tubing, wire, and powder metals. Properties, heat-treated. Ts, 200,000 psi; comp str, 205,000 psi; ys, 95,000 psi; elong in 2 in., 2.5%; impact str (Izod), 2-4 ft-lb; endurance limit, 40-50,000 psi; Rock hdns, C39-45; sp gr, 8.23; nonmagnetic; machinability when heat treated, poor; untreated, fair; weldability when untreated, fair; corrosion resistance, good to atmosphere, fresh and salt water, to certain alkaline and acid solutions; max cont serv temp, 300 F; abrasion resistance, high; electrical and thermal conductivity, high; resistance to drift and hysteresis, high. For springs and current-carrying members, contacts, bushings, diaphragms and other pressure responsive elements.

Berylco 275C: Be 2.7, Co 0.5, Cu balance. Pig or ingot, sand, permanent-mold, and precision castings. Properties, heat-treated: Ts, 175,000 psi; ys, 145,000 psi; elong in 2 in., 2-5%; impact str (Izod), 3-6 ft-lb; Rock hdns, C41-45; sp gr, 8.1; nonmagnetic; machinability when heat treated, poor; when untreated, fair; weldability when untreated, fair; resists corrosion caused by atmosphere, fresh and salt water, certain alkaline and acid solutions; max cont serv temp, 300 F; abrasion resistance, high; electrical and thermal conductivity, high. For plastic molds, small cast precision parts, current-carrying members, etc.

BESCOLOY (Alloy steel castings) — Brighton Electric Steel Casting Co., Beaver Falls, Pa.

Alloy steel: Ni 3, Cr 2, and Mo 7, Cr 2. Sand castings to specification. Ts, 115,000 psi; ys, 65,000 psi; elong in 2 in., 20; bhn (heat treated), 321. Machinability, fair; weldability, good; abrasion resistance, high.

BETH-CO-LITE (Tin plate)—Bethlehem Steel Co., Bethlehem, Pa.

Cold-reduced tin plate, hot-dip and electrolytic coatings.

BETH-CO-WELD (Butt-welded steel pipe) — Bethlehem Steel Co., Bethlehem, Pa.

BETH-CU-LOY (Copper-steel sheets) — Bethlehem Steel Co., Bethlehem, Pa.

Cu 0.20 min. Plain and galvanized.

BETHANIZED (Electrogalvanized, zinc-coated wire)—Bethlehem Steel Co., Bethlehem, Pa.

BETHCO (Steel wire) — Bethlehem Steel Co., Bethlehem, Pa.

Barbed wire, machine screw wire and wood screw wire.

BETHTELDUCTOR (High-tensile steel wire)—Bethlehem Steel Co., Bethlehem, Pa.

Bethanized (electrolytic zinc coated). For telephone and telegraph lines.

BETHLOC (Steel plate)—Bethlehem Steel Co., Bethlehem, Pa.

Low-carbon, high-ductility basic steel plates for standard railroad boiler-flange and firebox specifications.

BETHLEHEM (Steels and steel products) — Bethlehem Steel Co., Bethlehem, Pa.

Includes: Forgings, castings, bars and special sections, plates, flanged and dished heads, bolts, nuts, rivets and spikes, wheels and axles, frogs, switches and rails, steel sheets and strip, steel pipe, casing and tubing, tools, wire and wire products, wire rope, structural shapes, reinforcing bars, sheet and H-piles, fabricated steel construction.

In addition to the above products Bethlehem Steel Co. manufactures the following:

ALLOY STEELS: Complete line of electric furnace and open hearth steels including the entire range of AISI and SAE grades.

CARBON STEELS: All standard open hearth and bessemer carbon steels covering the complete AISI and SAE range.

CIRCULAR STEEL BLANKS: Forged and rolled for the manufacture of gears, crane wheels, sheave wheels, flywheels, turbine rotors, tire molds and rings, brake wheels and drums, and other similar products.

COLD-FORMED SHAPES: Regular or irregular shapes formed from strips, sheets and light plates.

TOOL STEELS: Complete range of carbon, low-alloy and high-alloy steels including carbon and carbon-vanadium tool and die steels, oil and air-hardening tool and die steels, shock-resisting steels, high-speed steels, hot-work tool steels, plastic molding die steels including cold-hobbing steels for master hobs and special-purpose tool steels.

BINNEY METAL (Heat-resisting castings) — Binney Castings Co., The, Toledo 7, O.

Castings for molds, valves, plungers, neck rings and other necessary mold parts for production of glass and other heat-resisting requirements. Both alloyed irons and bronzes. Also known as Min-Ox.

BIRDSBORO (Steel Castings)—Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.

Birdsboro "30" Steel: Steel castings to specification. Normalized and drawn: Ts, 85,000 psi; ys, 55,000 psi, elong in 2 in., 22%; machinability, good; weldability, good.

Birdsboro Carbon Steel: Steel sand castings to specification. Properties, normalized: Ts, 70,000 psi; ys, 30,000 psi; elong in 2 in., 24%; reduction of area, 36%; machinability, good; weldability, good.

Birdsboro 60-90: Steel sand castings to specification. Properties, normalized and drawn: Ts, 90,000 psi; ys, 60,000 psi; elong in 2 in., 22%; reduction of area, 45%; machinability, good; weldability, good.

BLAZECRETE (Gunning refractory) — Johns-Manville, New York 16.

For use as a gunning mixture in building new furnace linings and repairing old ones. Also unusually effective in heavy patching by troweling. Not recommended for casting purposes. Max cont serv temp, 3000 F.

BLUE ANCHOR (Drill rod) — Anchor Drawn Steel Co., Latrobe, Pa.

C 1.25, Si 0.25, Mn 0.25. Properties, water-quenched and tempered: Rock hdns, C65-67; abrasion resistance, medium; max cont serv temp, 300-500 F. For shafts, dowel pins, punches, dies, gages, etc.

BLUE RIDGE (Rolled patterned and wire glass) —Blue Ridge Glass Corp. Products sold by distributors of Libbey-Owens-Ford Glass Co., Toledo, O.

Sheet for cutting and bending into parts. Abrasion resistance, high; resists corrosion caused by everything except hydrofluoric acid; heat resistant to 130-154 F; flexibility, low; mod. of rupture, 6500 psi; comp str, 36,000 psi cube; moisture absorp, low; nonflammable; sp gr, 2.5; transparent and translucent types. For covers and safety guards, utilizing polished wire glass, or tempered glass.

BOHNALITE (Aluminum base alloy) — Bohn Aluminum & Brass Corp., Detroit.

Light alloy of which aluminum is the base. For forged connecting rods, cast cylinder heads, crankcases, transmission cases, and parts for vacuum cleaners, washing machines, shoe machinery, etc.

BOOTH (Wool-base felt) — Booth Felt Co., Brooklyn, N. Y.

Sheets or strips for machining or stamping into parts and precision-cut mechanical felt parts. Max cont serv temp, 400 F; ts, 5-100 psi; colors in all standard SAE types and grades. Used for washers, gaskets, grease seals and pads for insulating machinery or reducing vibration.

BOROD (Hard facing alloy)—Stoody Company, Whittier, Calif.

Fabricated steel rod containing regularly shaped particles of tungsten carbide of 40-down screen size. Hardness, 9-10 on Moh's scale. Provides maximum abrasion resistance; widely used on earth working equipment, on coal cutter bits, cane knives and for hard-facing small or thin parts. For oxy-acetylene and a-c, d-c electric application.

BOUND BROOK (Bearing bronzes) — Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.

Bushings, bearings and washers: Cast bronze inlaid with hard graphite lubricant in grooves or holes of various designs particularly adaptable to high temperatures, severe static loads, immersion in liquids, exposure to dusts or where oils are objectionable.

Graphited bronze bearings: Cu 81-85; Sn 6.25-7.5, Pb 6-8, Zn 2-4. Ts, 30,000 psi; ys, 14,000 psi; elong in 2 in., 12%; max cont serv temp, 500 F. For oil-less bearings in all types of machines.

BRAEMOW M-2 (High-speed steel)—Braeburn Alloy Steel Corp., Braeburn, Pa.

Mo-W high-speed steel containing C 0.82, Cr 4.20, V 1.90, W 6.50, Mo 5.00. Rough bars or billets, finished rods or bars. Recommended heat treatment: Heat to 2220 F, oil quench, then draw to 1050-1100 F. Rock hdns, C63-65. For all types of cutting tools.

BRANDYWINE (fiber) — Brandywine Fiber Products Co., Wilmington, Del.

Vulcanized fiber and phenol fiber paper-base material: Sheets, tubes and rods for machining and forming into parts. Abrasion resistance, medium; resists corrosion caused by weak acids; max cont serv temp, 300 F; flexibility, medium; dielectric str, 300 (volts per mil inst); moisture absorp, medium; in red, gray and black; shatterproof; sp gr, 1.35; opaque; machinability, good; takes high polish.

BRASSOID (Brass bonded to zinc)—American Nickeloid Co., Peru, Ill.

Zinc serves as rustproof, flexible and inexpensive white metal base. Available in variety of brilliant finishes and patterns, as sheets, flat strips and coiled strip for continuous feed automatic presses. Can be supplied with quick removable, gum-adhered paper covering, permitting drawing and preforming without marring prefinish.

BRIDGEPORT (Copper and zinc alloys)—Bridgeport Brass Co., Bridgeport, Conn. and Indianapolis, Ind.

Yellow brass: Cu 65, Zn 35. Sheet, wire and seamless tubing for drawing, stamping and cold heading.

Cartridge brass: Cu 70, Zn 30. Sheet for making small arms ammunition, artillery cartridge cases, eyelet machine parts, etc.

Low brass: Cu 80, Zn 20. Pale golden color. For parts requiring greater ductility and malleability than possessed by yellow brass.

Red brass: Cu 85, Zn 15. Fine golden color; corrosion resistant. For vanity cases, inexpensive jewelry.

Free-cutting brass rod: Cu 60, Pb 3, balance Zn. For making automatic screw machine parts.

Forging rods: Cu 60, Pb 2, balance Zn.

Commercial bronze: Cu 90, Zn 10. Sheet, rod, wire, and seamless tubing. Bronze color. For manufacturing stampings and drawn and cold-headed items for outdoor use. Stands weathering better than yellow brass.

Leaded brass alloys: Contain from 0.25-3.75% Pb to facilitate machining.

Nickel Silver 18% Grade B: Cu 55, Ni 18, Zn 27. Good spring properties when cold rolled; high electrical resistance. For spring contacts for telephone boards and radio.

Nickel Silver Grade A: Cu 65, Ni 18, Zn 17. Very malleable. Used as a base for silver-plated hollow ware, slide fasteners, etc.

Phosphor-bronze: Cu 92, Sn 8. For spring parts. Better spring properties than lower tin content.

Phosphor-bronze: Cu 95, Sn 5. Sheet spring quality for manufacturing switch parts.

Copper sheets and tubes for fabricating.

Aluminum Bronze 712: Strip form. Excellent spring properties when cold rolled. Often replaces phosphor bronze spring metals.

Bronze welding rods in variety of alloys for repairing iron and steel gears, frames, and other broken machine parts; for welding silicon bronze tanks and other production work.

BRIDGEPORT LEDRITE (Brass rod, free cutting)—Bridgeport Brass Co., Bridgeport, Conn. and Indianapolis, Ind.

Free-cutting brass rod: Cu 60, Pb 3, balance Zn. For making automatic screw machine parts.

BRIDGEPORT TUBING (Copper base tubing)—Bridgeport Brass Co., Bridgeport, Conn.

Condenser tubing: Admiralty metal for sea water, Cuzinal (aluminum brass) for har-

bor water, Muntz metal for fresh water, Duronze IV for aerated brackish water, Cupro-Nickel for most severe service and U. S. Navy requirements, and Arsenical copper for resisting corrosion better than straight copper in fresh water.

Duplex tubing: For two different types of corrosion inside and outside of tubing which are too severe for a single alloy. Steel, stainless steel, or aluminum outside or inside in combination with Admiralty brass, aluminum brass, copper or cupro nickel. For oil refining, refrigeration systems, chemical plants and food processing.

Copper water tubing: For industrial applications, and for pipe lines on board ship; also for air conditioning, plumbing and heating lines.

Brass and copper pipe for plumbing and heating lines.

BRONZE-ARC (Welding electrodes)—Alloy Rods Co., York, Pa.

Electrodes for welding brass, bronze and copper.

BRONZOCHROM (Overlays)—Eutectic Welding Alloys Corp., New York 13.

For torch overlaying against frictional wear on ferrous and nonferrous metals. These rods have low bonding temperature. Welds are machinable and have low frictional coefficients. Can be applied in thin layers without distortion or stresses.

BUFFALO (Wire cloth)—Buffalo Wire Works Co., Inc., Buffalo.

Wire cloth for every industrial use. Screens for abrasive material, chemicals and powder in plain steel, tinned, brass, copper, bronze, Monel and stainless steel. Also galvanized-after-woven wire cloth.

BUFLOKAST (Alloy cast iron)—Buflovak Equipment Div., Blaw-Knox Co., Buffalo 11, N. Y.

Sand castings to suit specification. Properties, heat-treated: Ts, 30-60,000 psi; bhn, 160-300; max cont serv temp, 1500 F; abrasion resistance, medium.

BUNDYFLEX (Tubing)—Everhot Products Co., Chicago 12, Ill.

Steel tubing, copper fused and copper coated both inside and outside. Can be bent to any shape, hard or soft soldered, brazed or welded and used for many purposes for which ordinary copper tubing was previously required. Strong and has high resistance to vibration fatigue. Used on passenger cars and trucks as fuel lines, oil filter lines, hydraulic brake lines, etc. Also on oil burners, refrigerators, farm tractors, airplanes, etc.

BUNDYWELD (Tubing)—Bundy Tubing Co., Detroit.

Steel tubing: SAE 1010 steel, in sizes ⅛ to ⅝ OD, in wall thicknesses from 0.020 to 0.049-in.

Monel tubing: Sizes ⅛ to ⅝-in. OD.

"L" Nickel tubing: Sizes ⅛ to ⅝-in. OD.

BUNTING (Bearing bronzes) — The Bunting Brass & Bronze Co., Toledo, O.

Precision-machine cored and solid bar stock. Over 1000 sizes of standardized fully-finished stock bearings for machinery applications. All cast in accordance with bearing bronze spec. SAE 660 (QQB-691, Grade 12). Special sizes made to blueprint from SAE, AMS, ASTM, Federal, Navy and Air Corps specifications and from the company's recognized standard bronze bearing alloys, as follows:

No. 72, SAE 660: Cu 83, Sn 7, Pb 7 and Zn 3. General-purpose bearing bronze.

No. 27: Cu 80, Sn 10 and Pb 10. General-purpose bearing bronze.

No. 96: Cu 87.5, Sn 10, Pb 2.5. Hard leaded bronze for heavy pressures and moderate speeds. Good physical properties fit it for heavy duty equipment such as diesel engine piston pin bushings, connecting rod liners, valve guides, etc.

No. 98: Cu 88, Sn 10 and Zn 2. Hard bronze for severe service and heavy pressures. Allowance of 1% lead content improves machinability and bearing characteristics without impairing physicals. Used in aviation engines.

No. 124: Cu 85, Sn 5, Pb 9 and Zn 1. Excellent in automotive camshaft and piston pin applications.

No. 125: Cu 75, Sn 5 and Pb 20. Good anti-friction properties.

No. 135: Cu 77, Sn 8, Pb 15. Finished bushings and bearings. Ts, 28,000 psi; comp str, 18,000 psi; ys, 14,000 psi; elong in 2 in., 15%; bhn, 52; machinability, good. Suited to medium load and speed conditions. For seal rings, marine propeller shaft strut bearings, etc.

No. 143: Cu 85, Sn 14, Pb 1. Finished rods or bars, sand and permanent-mold castings. Properties, unheat-treated: Ts, 40,000 psi; compr str, 24,000 psi; ys, 15,000 psi; elong in 2 in., 10%; bhn, 76; machinability, poor. Hard high-tin bronze used where excessive shock loads or pressures demand added strength.

No. 147: Cu 88, Sn 8, Pb 1, Zn 3. Finished rods or bars, sand and permanent-mold castings. Properties, unheat-treated: Ts, 35,000 psi; comp str, 21,000 psi; ys 17,000 psi; elong in 2 in., 15%; bhn, 60; machinability, good. Leaded gun metal used in applications where heavy loads and severe working conditions must be withstood.

No. 156: Cu 89, Sn 11. Finished rods or bars, sand and permanent-mold castings. Properties, unheat-treated: Ts, 40,000 psi; compr str, 22,000 psi; ys, 18,000 psi; elong in 2 in., 20%; bhn, 67; machinability, fair. Gear bronze.

No. 158: Cu 70, Sn 5, Pb 25. Connecting rod liners, water pump bushings and seals.

No. 162: Cu 70, Sn 9, Pb 21. Finished rods or bars, sand and permanent-mold castings. Properties, unheat-treated: Ts, 30,000 psi; compr str, 20,000 psi; ys, 15,000 psi; elong in 2 in., 15%; bhn, 55; machinability, good. For water pump bushings, seals, etc.

No. 164: Cu 86, Sn 11, Pb 1.5, Ni 1.5. Gears and synchronizer rings.

No. 183: Cu 64, Sn 4, Pb 4, Zn 8, Ni 20. Sand castings to specification. Ts, 45,000 psi; ys, 27,000 psi; elong in 2 in., 15%; bhn, 95; nonmagnetic; not weldable; abrasion resistance, medium. For bearings in contact with certain corrosive fluids and gases.

Aviation and machine tool bearings and transmission cones are sand, chilled or centrifugally cast and machined to the utmost precision dimensions and surface finishes.

BUTACITE (Polyvinyl butyral plastic)—E. I. du Pont de Nemours & Co., Inc., Polychemicals Dept., Wilmington, Del.

Thermoplastic. Sheets and flakes for adhesive coatings and laminating. Soluble in esters, alcohols, ketones, chlorinated hydrocarbons; insoluble in aliphatic hydrocarbons; stable in dilute alkalies and slowly decomposed in dilute acids. Dielectric str, 360 volts per mil; ts, 2000 psi; moisture absorp, high; sp gr, 1.07; transparent. For safety glass.

BUTAPRENE (Synthetic rubber)—Firestone Tire & Rubber Co., Akron.

For molding, extruding, calendering and spreading. Resistance to fuels and oils, extremely high; abrasion resistance when properly compounded, high; resists corrosion caused by most acids, alkalis and salts; max cont serv temp, 300 F; flexibility, high; ts, up to 3500 psi; moisture absorp, low; takes color; shatterproof at temperatures above —65 F; sp gr, 0.96-1.0; translucent. For all automotive and aeronautical rubber parts requiring resistance to oils and fuels and marine and filling station pumps. Also available as a latex for cements, adhesives and dispersions.

B & W (Firebrick)—The Babcock & Wilcox Co., Refractories Div., New York 6.

Ceramics: Standard or special refractory shapes; fabricated by molding and kiln firing.

Junior Firebrick: Serv temp, 2850 F; fusion point, 3173 F; conductivity, Btu/sq ft/hr/deg F/in. at mean temp of 1600 F, 11.50; melting point, high; creep strength, high; low volume change at elevated temperatures.

80 Firebrick: Serv temp, 2950 F; fusion point, 3190 F; conductivity, Btu/sq ft/hr/deg F/in. at mean temp of 1600 F, 12.75; melting point, high; creep strength, high; low volume change at elevated temperatures.

Insulating Firebrick: Various grades, ranging in serv temp from 1600-2900 F; fusion points from 2700-3190 F; conductivity, Btu/sq ft/deg F/in. at mean temp of 1500 F, 1.24-3.15; cold crushing strength, 48-308 psi; modulus of rupture, 41-283 psi. All have high resistance to heat flow, are lightweight, and have low heat storage.

All are used for linings in all types of furnaces for industries such as ceramics, gas generators, chemicals, oil refining, power, steel producing and processing, etc.

D & W 5202 (Alloy cast steels)—The Babcock & Wilcox Co., New York 6, N. Y.

High carbon, alloy steel castings. Properties, machined and final heat treated state: Ts, 150,000 psi; bhn, 500-650; abrasion resistance, high. For grinding and crushing machinery.

B & W Croloy (Steel tubing)—The Babcock & Wilcox Tube Co., Beaver Falls, Pa.

½: C 0.10-0.20, Cr 0.50-0.70, Mo 0.45/0.65, Si 0.10-0.30. For high-temperature piping; max cont serv temp, 1000 F in steam, slightly higher in oil refining; superior to carbon molybdenum with respect to graphitization and high-temperature load-carrying ability.

1: C 0.15 max, Cr. 0.80-1.10, Mo. 0.45-0.6 Si 0.30. max. For high-temperature piping boiler and superheater tubes.

1¼: C 0.15 max, 1-1.5, Mo 0.45-0.65, 0.5-1. Max cont serv temp, 1025 F in steam slightly higher in oil refining; creep strength where limited corrosion and oxidation resistance are required, fair.

2: C 0.15 max, Cr 1.75-2.25, Mo 0.45-0.6 Si 0.5 max. For refinery and superheater tubes. Corrosion and heat-resistant nominal temperatures.

2¼: C 0.15 max, Cr 2-2.25, Mo 0.9-1.1, 0.5 max. For refinery and superheater tubes where high creep strength is required.

3M: C 0.15 max, Cr 2.75-3.25, Mo 0.8-1, 0.5 max. Max cont serv temp, 1000 to 105 F in steam, 1175 in refinery applications creep properties, good; corrosion resistance superior to Croloy 2 or 2¼.

5: Chromium molybdenum. C 0.15 max. 4.6, Mo 0.45-0.65. For oil refinery service and for steam superheaters; creep properties good; resistance to oxidation, good; max cont serv temp, 1050 F for steam and 120 F for refinery applications.

7: C 0.15 max, Cr 6-8, Mo 0.90/11.10. 1.05 1.30, 1.20/1.50. Semistainless alloy. Physical properties and corrosion resistance, good

Also stainless steel tubing, seamless and/or welded furnished to AISI types. For information on types, properties and characteristics see "stainless steels" listing at end of this section.

BYERS GENUINE (Wrought Iron)—A. M. Byers Co., Pittsburgh 30.

Two-component metal of high purity iron and iron silicate: Pipe, tubing, plate, sheet, rod or bar and bloom or billet for forging. Magnetic; weldability, good; resists corrosion caused by various chemical and electrochemical reactions; abrasion resistance, high. For any part where resistance to corrosion and/or fatigue is essential.

CADNICKEL (cadmium-nickel treated babbitt)—Randall Graphite Bearing Inc., Chicago 6

Properties: Ult str, 14,800 psi; ys, 11,120 psi; bhn, 30.

CR-39 (Thermosetting plastics)—The Homalite Corp., Wilmington 166, Del.

Sheet form: Abrasion resistance, very high; chemical resistance, excellent; max cont serv temp, over 300 F; slow burning; flexibility, medium; dielectric str, 523 (volts per mil. inst); ts, 6000 psi; comp str, 22,000 psi; flex str, 8000-10,000 psi at 25 C; elong and compr set, low; moisture absorp, low; in clear sheet only; not shatterproof; Rock hdns, M100; coef of thermal exp'n, low. For aircraft windows, bus and truck panels, etc.

CALCERITE (Melamine formaldehyde plastic)—Furane Plastics and Chemicals Co., Glendale, Calif.

Melamine formaldehyde thermosetting plastic powder for casting into parts. Abrasion resistance, medium; max cont serv temp, 300 F; flex str, 5000 psi; compr str, 12,000 psi; variety of colors; moisture absorp, medium; sp gr, 1.65; machinability, fair.

CALITE (Heat-resisting cast steels)—Calorizing Co., Pittsburgh.

"A": Ni-Cr alloy (Ni 35, Cr 16). Creep strength, good; max cont serv temp. 2000 F; bhn (as cast), 200. For hearth plates, enameling supports, chain, and general mechanical parts in furnaces. Also available in rolled bar stock.

"B-28": Cr 25, Ni 10, Mo 1.00. For furnace parts. Max cont serv temp, 1950 F. Combines great high temperature strength with freedom from embrittling tendency in service.

"B-29": For furnace parts. Max cont serv temp, 2050 F.

"N": Sheets, bars and castings. Max cont serv temp, 2100 F. Parts subject to uneven heating or rapid, irregular temperature changes.

"E": Bars and sheets. Max cont serv temp, 1600 F.

"E-28": Bars and sheets. Max cont serv temp, 1950 F.

CALUMETAL (Alloy steel castings)—Calumet Steel Castings Corp., Hammond, Ind.

Alloy G: Cr-Ni alloy steel. Properties, heat-treated: Ts, 115-210,000 psi; ys, 85-173,000 psi; elong in 2 in. (min), 18-6%; bhn, 200-600. For parts requiring high strength and high elasticity.

Alloy BR: Mn-Mo alloy steel. Properties, heat-treated: Ts, 85-120,000 psi; ys, 60-95,000 psi; elong in 2 in. (min), 18-30%; bhn, 150-250; machinability, good. For parts requiring structural rigidity and high wear resistance.

Alloy GH: High-carbon, Cr-Ni alloy steel. Properties, heat-treated: Ts 100-180,000 psi; ys, 80-120,000 psi; elong in 2 in. (min), 10-20%; bhn 200-400. For parts requiring high abrasion resistance or where high hardness is required.

Alloy M: Cr-Mo alloy steel. Properties, heat-treated: Ts, 100-175,000 psi; ys, 75-120,000 psi; elong in 2 in. (min), bhn, 200-400. For elevated-temperature applications to 1000 F; also parts requiring high abrasion resistance.

Alloy GR: Medium carbon, Cr-Ni steel. Properties, heat-treated: Ts, 80-120,000 psi; ys, 55-90,000 psi; elong; elong in 2 in. (min), 20-30%; bhn, 150-300. For castings requiring high abrasion resistance and good machinability.

CALSTRIP (Carbon steel) — California Cold Rolled Steel Corp., Los Angeles 22.

Low-carbon cold-rolled steel: Straight and coiled strip. For low-strength parts requiring high ductility and softness. Formability, good.

CAMET (Powder-metal parts)—Chicago Powdered Metal Products Co., Schiller Park, Ill.

Custom-molded powder-metal parts of the following materials:

Camet 12: Cu 80, Zn 20. Ts, 34,100 psi; Rock hdns, F30; sp gr, 7.5; porosity (% by volume), 15.

Camet 24: Cu 90, Sn 10. Ts, 13,000 psi; Rock hdns, F20; sp gr, 6.2; porosity (% by volume), 30.

Camet 26: Cu 90, Sn 10. Ts, 25,000 psi; Rock hdns, F30; sp gr, 7.0; porosity (% by volume), 21.

Camet 42: Fe 93, Cu 7. Ts, 32,000 psi; Rock hdns, B50; sp gr, 5.5; porosity (% by volume), 30.

Camet 47: Fe 93, Cu 7. Ts, 40,000 psi; Rock hdns, B65; sp gr, 5.9; porosity (% by volume), 25.

Camet 61: Fe 99, C 1. Ts, 29,000 psi; Rock hdns, B30; sp gr, 5.8; porosity (% by volume), 26.

Camet 65: Fe 99, C 1. Ts, 48,000 psi; Rock hdns, C32; sp gr, 6.0; porosity (% by volume), 24.

Camet 68: Fe 99, C 1. Ts, 70,000 psi; Rock hdns, C58; sp gr, 6.9; porosity (% by volume), 12.

Camet 98: Fe 99+. Rock hdns, F65; sp gr, 7.0; porosity (% by volume), 11.

CAMBRIDGE (Woven wire belting)—Cambridge Wire Cloth Co., Cambridge, Md.

A flexible wire belt used in processing, mechanical, food, glass, ceramic and metal-working fields.

CARBOLOY (Cemented carbide) — Carboloy Company, Inc., Detroit.

Series of cemented carbides basically made from tungsten carbide and a softer cementing element such as cobalt. In certain grades, supplementary ingredients are the carbides of tantalum, titanium or other metals. Abrasion resistance, outstandingly high; compr str, as high as 800,000 psi. Rock hdns, A86-93; noncorrosive under normal conditions. Has moduli of elasticity and torsion approximately three times that of steel thus providing great rigidity. Suitable for use where high rigidity, density and abrasive resistance are required such as facings for valve lifters and valve ends in automotive engines, cam followers, ceramic molds, cold forging dies, guide rings, spray nozzles, valve seats and valves, powder metal molds and plungers, boring bars, etc.

CARBON-MOLY .50 (Welding electrode) — Metal & Thermit Corp., New York 5.

Ac or dc, down-hand. Cut length and coiled. Joint properties: Ts, 70-83,000 psi; elong in 2 in., 25-34%. AWS E7020.

CARCOLOY (Alloy iron castings)—Pacific Car & Foundry Co., Renton, Wash.

Sand castings to specification. Properties, unheat treated: Ts, 55-65,000 psi; endurance limit, 0.50 ts; bhn, 260-340. Properties, heat treated: Ts, 65-85,000 psi; endurance limit, 0.50 ts; bhn, 260-340. Magnetic; machinability, good; weldability, fair; abrasion resistance, medium. For diesel engine crankshafts and similar reciprocating parts subject to high torsional vibration.

CARCOMETAL (Alloy steel castings)—Pacific Car & Foundry Co., Renton, Wash.

C 0.08-0.22, Mn 0.90-1.65, Si 0.75-1.50, Cu 1.00-2.00. Sand castings to specification. Properties, unheat treated: Ts, 75-95,000 psi; ys, 65-85,000 psi; elong in 2 in., 18-30%; imp str (Charpy), 15-35 ft-lb; endurance limit, 0.42 ts; bhn, 160-180. Properties, heat treated: Ts, 100-200,000 psi; ys, 150-185,000 psi; elong in 2 in., 15-25%; imp str (Charpy), 12-30 ft-lb; endurance limit, 0.45 ts; bhn, 325-400. Magnetic; machinability, good; weldability, good; abrasion resistance, high. Principally recommended for structural castings requiring high elastic strength and fatigue properties where thin wall sections and extreme lightness are required.

CARDOLITE (Resins)—Irvington Varnish & Insulator Co., Irvington, N. J.

Derived from cashew nut shell liquid, a high molecular weight unsaturated material with phenolic characteristics. Includes brake-lining binders, friction fortifiers and types used in manufacture of electrical insulation; laminating, impregnating and sealing resins.

CARLON (Polyethylene plastic pipe and tube)—The Carlon Products Corp., 10225 Meech Ave., Cleveland 5, O.

Pipe and tubing, flexible and rigid to specified application. For transmission of fluids for human and animal consumption, corrosive gases, air, chemical solutions, or sewage. Properties: Ts, 1400 psi; flex str, 1700 psi; sp gr, 0.9-0.99; imp str (notched), 3-6 ft-lb; dielectric str, 500 (volts per mil inst); max cont serv temp, 140-180F; does not brittle at —70F; nonmagnetic; nontoxic, does not scale; noncorrosive. Sizes: Flexible pipe, ½-6-in. diameters; rigid pipe, ½-12-in. diameters; tubing, ¼-1-in. diameters. Weights: Flexible pipe, 0.103 lb (1 ft of ½-in.), 0.445 lb (1 ft of 2-in.), 2.23 lb (1 ft of 6-in.); rigid pipe, 0.05 lb (1 ft of ½-in.), 0.45 (1 ft of 2-in.). Bursting pressures: Tubing, 800 psi (¼-in.), 290 psi (1-in.); flexible pipe, 540 psi (½-in.), 115 psi (6-in.); rigid pipe, 840 psi (½-in.), 550 psi (2-in.). Fittings and couplings available for plastic to plastic, plastic to copper, or plastic to steel connections.

CARPENTER (Stainless and alloy steels)—The Carpenter Steel Co., Reading, Pa.

Stainless steels in standard forms. For type, property and application data on these see "Stainless Steels" listing at end of this section.

No. 5-317: C 0.5, Cr 1.0, Ni 1.75. For gears, clutches, shafts, crankshafts, propellers.

No. 158: C 0.1, Cr 1.5, Ni 3.75. For case-hardened high-duty clash gears, shafts, clutch parts.

Samson No. 2: C 0.15, Cr 0.6, Ni 1.25. For general case-hardened parts, gears, studs, bolts, roller bearings, set screws.

Samson No. 4: C 0.4, Cr 0.6, Ni 1.25. For tempered set screws, shanks of high-speed tools, machine tool parts.

Samson No. 4-A: C 0.4, Cr 0.6, Ni 1.25. For axles, steering knuckles, crankshafts.

Samson No. 4-C: C 0.4, Cr 0.6, Ni 1.25. For cold-drawn parts requiring great strength and toughness.

Samson No. 5: C 0.5, Cr 0.6, Ni 1.25. A "gear temper" steel for clash gears, clutch parts, stops, etc., requiring good wear resistance plus strength and toughness.

No. 874 Triple Alloy Steel: C 0.43, Cr 0.15, Ni 0.5. Tough tempering alloy steel for axles, shafts, studs, gears, bolts, tool shanks, etc.

Presto: C 1.05, Cr 1.4. For ball races.

21-12 Valve Steel: C 0.20, Cr 20.50, Ni 11.50. For exhaust valves. Highly resistant to corrosion and oxidation.

21-12N Valve Steel: C 0.20, Cr 20.50, Ni 11.50. For exhaust valves. Highly resistant to corrosion and oxidation. Nitrogen used for increased high temperature strength.

Silicon Iron "A": C 0.08 max, Mn 0.15 max, Si 1.00. For solenoid switches, armatures, relays, etc.

Silicon Iron "C": C 0.08 max, Mn 0.15 max, Si 4.00. For solenoid switches, armatures, relays, etc.

Glass Sealing "27": C 0.15 max, Cr 28.0. For glass-to-metal seals.

Glass Sealing "42": C 0.15 max, Mn 1.0, Ni 41.5. A low-expansion alloy, with expansion characteristics closely matching certain soft glasses. Valuable as a sealing alloy.

High Permeability "49": C 0.1 max, Ni 49.0. For instrument transformer cores, magnetic shields, etc. Provides high magnetic permeability particularly at low field densities.

HyMu "80": C 0.1 max, Ni 80.0, Mo 4.0. For special transformer cores, magnetic shields and supersonic equipment requiring extremely high initial permeability.

Temperature Compensator "30": C 0.15, Ni 30.0. Used as a shunt on permanent magnets to compensate for temperature variations.

High-Expansion Alloy: C 0.55, Mn 4.50, Cr 4.00, Ni 12.50. For applications requiring high expansion.

Stainless No. 20: C 0.07, Si 1.00, Cr 20.00, Ni 29.00, Mo 2.00, Cu 3.00. Superior corrosion resistance in H_2SO_4 and retains mechanical properties as good as those of 18-8 stainless alloys.

Stainless No. 10: C 0.08 max, Cr 16.00, Ni 18.00. For cold heading. Corrosion resistance equal to Types 304 and 305.

CARRARA (Structural glass)—Pittsburgh Plate Glass Co., Pittsburgh 19.

Plate glass generally chemical resistant; nonflammable; flexibility, low; ts, 3500 psi; moisture absorp, low; in black, white, ivory, gray, beige, jade, forest green, wine, orange and Rembrandt blue; sp gr, 70 F, 2.43. For work surfaces, separators, etc.

CASTEEL (Carbon steel castings) — Calumet Steel Castings Corp., Hammond, Ind.

"28": C 0.23-0.33. For structural and machine castings. Properties (fully annealed): Ts, 60-75,000 psi; ys, 30-45,000 psi; elong in 2 in., 25-35%; reduction in area, 30-50% bhn, 125-145.

"40": C 0.35-0.45. For gears, racks, sprockets, and machinery frames. Properties (fully annealed): Ts, 80-95,000 psi; ys, 45-60,000 psi; elong in 2 in., 20-30%; reduction in area, 25-45%; bhn, 150-190.

CATABOND (Bonding resin)—Catalin Corp. of America, New York.

Phenolic base, thermosetting: Liquid resin for laminating and bonding; nonflammable; moisture absorp, low; fungi resistant. Used for abrasive wheels, laminated products, surface coating, impregnating and bonding.

CELITE (Diatomaceous silica materials)—Johns-Manville, New York 16.

Powdered, granular and brick forms: Resistant to chemical corrosion; heat-resistant; nonflammable. Brick used for insulation of equipment operating at high temperatures; powder used as filter-aid for cutting fluid purification, fillers, etc.

CELL-TITE (Soft and hard rubber) — Sponge Rubber Products Co., Shelton, Conn.

Soft rubber, thermosetting: Sheets, rods or tubes. Abrasion resistance, low; resists corrosion caused by acids and alkalies; flexibility, high; ts, to 150 psi; moisture absorp, very low; in color; shatterproof; sp gr, 0.165-0.5; opaque; machinability, fair. For insulation.

Hard, thermosetting and thermoplastic: Sheets, rods or tubes and in laminated and molded (board) form. Abrasion resistance, low; resists corrosion caused by acids, alkalies; max cont serv temp, 285 F; flexibility, medium; ts, 100-300 psi; comp str, 100-450 psi; flex str, 500-1500 psi; moisture absorp, low; shatterproof; sp gr, 0.08-0.50; opaque. For insulation and flotation.

CEL-O-GLASS (Plastic-coated wire mesh)—E. I. du Pont de Nemours & Co., Organic Chemicals Dept. Wilmington, Del.

Transmits ultra-violet rays; resistant to shock; translucent; flexible; light in weight. Used where an opalescent or translucent, flexible material is required.

CELORON (Thermosetting plastics) — Continental-Diamond Fibre Co., Newark 23, Del.

Phenol formaldehyde, thermosetting; furnished in molded parts and laminated forms; abrasion resistant; resistant to gasoline, kerosene, oil, grease, alcohol, acids and weak alkalies. Max cont serv temp, 250 F; flexural str, 21,000 psi (ASTM D-229-42); dielectric str, 220 volts per mil; ts, 11,000 psi; comp str, 40,000 psi; impact str, 3.6 ft-lb (Izod); mottled tan and black; moisture absorp, low; sp gr, 1.35; opaque. For electrical insulation, gears, pinions, cams, bushings, pulleys, casters, clutches, filter plates, handles, housings, etc.

CELLULAK (Shellac thermosetting material) — Continental-Diamond Fibre Co., Newark 23, Del.

Tubes, for compression rolling. Abrasion resistance, medium; resistant to oils and greases. Max cont serv temp, 180 F; dielectric str (750 volts per mil inst); machinability, fair; opaque. For electrical insulation and oil resistant spacers.

CEMCO (Aluminum alloys)—The Cleveland Electro Metals Co., Cleveland 13.

Aluminum alloys to specification in the form of pig or ingot, rough bars or billets, and permanent-mold castings.

CENTRALINE (Wood-cellulose fiber) — Central Paper Co., Inc., Muskegon 28, Mich.

Wood-cellulose fiber, bleached or unbleached, or of specialty fiber, coated or saturated with plastic materials. Rolls or sheets, both plain and laminated of two or more thicknesses. Abrasion-resistant; resists corrosion caused by atmospheric conditions; heat-resistant; flexible or stiff; dielectric strength varies with final thickness of paper; ts, 7500-8500 psi; moisture absorp, varied; in color; translucent or opaque. For coils, motors, gaskets, shims, noncorrosive separations, insulating, filtering, etc.

CENTRALLOY (Alloy iron castings)—Centrifugal Foundry Co., Muskegon, Mich.

Nos. 1-6: C 2.90-3.40, Si 1.70-2.30, Mn 0.60-0.90, S 0.10 max, P 0.10-0.20, Cr 0.20-0.80 Ni 0.40-2.00, Mo 0.20-0.60. Tubes and permanent-mold castings. Machinability, good; abrasion resistance, high. Low scrap losses during machining. For cylinder liners and piston rings.

CERAWARE (Ceramics)—General Ceramics & Steatite Corp., Keasbey, N. J.

Ceramic material for molding, casting, machining and extruding. Abrasion resistance, high; resists corrosion except by hydrofluoric acid and caustic alkalies; flexibility, low; max cont serv temp, 250 F; ts, 200 psi; comp str, 80,000 psi; moisture absorp, low; sp gr, 2.2; opaque; machinability, grinding only. For chemical equipment generally.

CEREX (Heat-resistant thermoplastic) — Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Molding granules for injection and extrusion molding; adaptable to automatic machine blowing. Markedly better heat resistance than other thermoplastics; in general, molded parts may be boiled without loss of shape or strength. Color range includes colored transparents, translucents and opaques. Excellent dimensional stability. Somewhat improved mechanical properties over polystyrene including better shock strength; electrical properties better than any other rigid thermoplastic except Lustron.

CERROBASE (Low-melting-point alloy) — Cerro de Pasco Copper Corp., New York.

Bismuth-lead: Casting alloy which expands on cooling. Melt pt, 255 F; ts, 6100 psi. Recommended for autoclaves, liquid seal for nitriding furnaces, electroforming, etc.

CERROBEND (Low-melting-point alloy) — Cerro de Pasco Copper Corp., New York.

Bismuth-lead-tin-cadmium: Casting alloy which expands on cooling and has extremely low melt pt, 158 F. Ts, 6000 psi. Useful as a fusible alloy and as a filler for tube bending.

CERROLOW-117 (Low-melting-point alloy) — Cerro de Pasco Copper Corp., New York.

Bismuth-lead-tin-cadmium-indium: Cake and ingot and formed by casting. Melt pt, 117 F; ts, 5400 psi; bhn, 12; weight, 0.32 lb per cu in.; shrinkage upon cooling of 0.0002-in. per in. makes it useful for proof casting. Used as fusible alloy in thermal safety devices, alarms, etc.

CERROMATRIX (Low-melting-point alloy)—Cerro de Pasco Copper Corp., New York.

Bismuth-lead-tin-antimony: Casting alloy. Melt pt, 248 F and expands on cooling. Ts, 13,000 psi. For locating and anchoring punches in dies and machine parts in cored holes.

CERROSAFE (Low-melting-point alloy) — Cerro de Pasco Copper Corp., New York.

Bismuth-lead-tin-cadmium: Cake or ingot and formed by casting. Ts, 5400 psi; ys, 300 psi; bhn, 9; weight, 0.341 lb per cu in.; nonmagnetic. Shrinks slightly on solidification; grows in one hour to original cold-mold dimensions. Used as proof casting medium, spray coating of wood patterns and core boxes, duplicate patterns in making match plates.

CERROSEAL (Metal-to-glass solder)—Cerro de Pasco Copper Corp., New York.

Indium-tin alloy: Cake or ingot form. Melt pt, between 240 and 250 F. Adheres to glass and used to join glass to glass, and glass to metal for vacuum seals.

CERROTRU (Low-melting-point alloy) — Cerro de Pasco Copper Corp., New York.

Bismuth-tin: Cake or ingot and formed by casting. Melt pt, 281 F; ts, 8000 psi; ys, 500 psi; bhn, 22. Expands 0.0007-in. per inch during solidification, shrinks to 0.0005-in. in cooling to room temperature.

CHACE (Thermostatic bimetal)—W. M. Chace Co., Detroit 9.

A number of combinations including alloys of nickel-iron, nickel-iron-chromium, nickel-iron-manganese, pure nickel, etc.: Responsive to various temperature ranges and provide a wide range of deflection rates and electrical resistivities. For temperature control elements in controllers, recorders, indicators, etc.

CHAMET (Bronze)—Chase Brass & Copper Co., Waterbury 20, Conn.

Type A: Cu 60.5, Sn 0.75, Zn 38.75. For shafting and structural and engineering uses.

Type B: Cu 63.5, Sn 0.75, Zn 35.75. For general cold heading and upsetting purposes.

CHASE (Brasses and bronzes) — Chase Brass & Copper Co., Waterbury 20, Conn.

Leaded commercial bronzes: Cu 89, Pb 2, Zn 9. For screw machine parts requiring good physical properties and high corrosion resistance.

Also various high and low brasses and bronzes in various forms to meet specific requirements for a variety of mechanical parts.

CHASE TELLURIUM COPPER — Chase Brass & Copper Co., Waterbury 20, Conn.

Cu 9.5, Te 0.5. Finished rods or bars and tube for hot forging, extruding, turning, boring, etc.; corrosion resistant; abrasion resistance, medium; ts, 32-55,000 psi; ductility, medium; bhn, untreated, 90. For electrical connections, parts for electric motors, switches, etc.

CHEMACO (Thermoplastic plastics) — Koppers Co. Inc., Chemical Div., Pittsburgh 19.

Cellulose acetate thermoplastic. Granules for molding and extruding. Abrasion resistance, high; resists corrosion caused by weak acids, weak alkalies and hydro carbons; flex str, 1500-12,000 (volts per mil inst), (ASTM D 650-42T); dielectric str, 290-365 (⅛-in. thickness); ts, 3000-10,000 psi; comp str, 5000-30,000 psi; moisture absorp, medium; in color; sp gr, 1.27-1.37; transparent, translucent and opaque; machinability, excellent. For knobs, dials, controls, wheels, electrical insulation, shields, nameplates, washers, housings, etc.

Ethyl cellulose thermoplastic. Granules for molding and extruding. Abrasion resistance, low; resists corrosion caused by weak acids and alkalies; max cont serv temp, 140-220 F; flexibility, low; flex str, 3500-12,000 psi (ASTM D-650-42T); dielectric str, (400-700 volts per mil inst), (⅛-in. thickness); impact str, 6-11.5 ft lb (Izod); ts, 3000-10,000 psi; comp str, 8000-20,000 psi; moisture absorp, low; in pastels; sp gr, 1.07-1.18; translucent; machinability, good. For knobs, controls, trim, nameplates, etc.

Polystyrene, thermoplastic. Granules for molding and extruding. Abrasion resistance, high; resists corrosion caused by alkalies and weak acids; max cont serv temp, 150-190 F; flex str, 8000-19,000 psi (ASTM D 650-42T); dielectric str, 3500 (volts per mil inst), (0.005-in. thick); ts 5000-9000 psi; comp str, 11,500-15,000 psi; moisture absorp, low; in color; sp gr, 1.054-1.056 (unpigmented); transparent, translucent and opaque. For use as knobs, dials, controls, wheels, electrical insulation, shields, etc.

CHEMALLOY (Cast stainless steel)—Electro-Alloys Div., American Brake Shoe Co., Elyria, O.

F, A and H series: Ferritic, austenitic and nickel-base alloys furnished in sand castings to specification.

CHEMALLOY N SERIES (High-alloy cast iron)—Electro-Alloys Div., American Brake Shoe Co., Elyria, O.

Sand castings to specification. Sp gr, 7.3-7.4; machinability, good; weldability, fair; max cont serv temp, 1500 F; abrasion resistance, high; corrosion resistance, good; anti-galling.

CHEMIGUM (Synthetic rubber)—Goodyear Tire & Rubber Co., Akron 16, O.

Butadiene acrylonitrile, synthetic rubber. Thermoplastic. For molding and extruding into parts. Abrasion resistance, high; resists corrosion caused by acids, alkalies and oils. Good low-temperature flexibility; ts, 3500 psi; moisture absorp, low; nonstaining. For gaskets, seals, vibration dampeners, hose, tubing and general rubber compounding.

CHLORIMET (Casting alloys) — The Duriron Co., Inc., Dayton 1, O.

No. 2: (Ni-Mo cast alloy): Ni 62, Mo 32, Fe 3, C 0.10. Sand castings to specification. Ts, 80,000 psi; ys, 55,000 psi; elong in 2 in., 5%; bhn, 250; nonmagnetic; weldability, good; resists hydrochloric acid at all concentrations and temperatures, hot sulfuric acid under reducing conditions, and wet hydrogen chloride gas.

No. 3: Ni 60, Mo 18, Cr 18, Fe 3, C 0.07. Sand castings to specification. Ts, 75,000 psi; ys, 50,000 psi; elong in 2 in., 10%; bhn, 225; nonmagnetic; weldability, good; resists most acids, particularly under oxidizing conditions.

CHROMALOID (Chromium bonded to nickel-bonded zinc) — American Nickeloid Co., Peru, Ill.

Zinc serves as rustproof, flexible and inexpensive white metal base. Available in variety of brilliant finishes and patterns, as sheets, flat strips and coiled strip for continuous feed automatic presses. Can be supplied with quickly removable, gum-adhered paper covering, permitting drawing and forming without marring pre-finish.

CHROMANAL (Alloy steel castings)—American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

Manganese steel castings: C 1-1.4, Mn 10-14, Si 0.2-1.0, Cr 1-3.0. Ts (heat-treated), 95-145,000 psi; ys, 53-65,000 psi; elong in 2 in., 2-63%; reduction in area, 30-40%; bhn, 195-220 (work hardens up to bhn 550); magnetic permeability, 1.003-1.10; weldability, good; max cont serv temp, 500 F; abrasion resistance, medium. Less flow under impact than standard manganese steel; other properties similar. For crusher parts, hammer mill parts, grinding mill liners, etc.

CHROMAX (Nickel-chromium iron alloy)—Driver-Harris Co., Harrison, N. J.

Ni 35, Cr 19, and balance Fe. Heat-resisting alloy used for carburizing containers or furnace parts.

CHROME-BORIDE (Welding electrodes) — Alloy Rods Co., York, Pa.

Electrodes for extreme abrasion and moderate impact resistance.

CHROMEFACE (Welding rods and electrodes)—American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

C 4.0, Mn 6.0, Si 2.0, Cr 30.0. Bhn, 500-800; abrasion resistant to 600 F. For hardfacing only; austenitic iron deposits; slightly magnetic; abrasion resistance, good in fine-grained soils. Excellent for hardfacing plowshares, disks, and other agricultural parts subject to soil abrasion.

CHROMEL (Nickel base and nickel-chrome alloys)—Hoskins Mfg. Co., Detroit 8.

Alloy 502: Ni 35, Cr 18½, balance mainly Fe. Castings, rod, bars, and strips. For general heat-resistant applications and for mechanical and load-carrying members.

Alloy 667: Nickel alloy of Mn 4, Si 1, Ni balance. Ribbon strip and wire, for machining, stamping, drawing, bending and forming, resistance welding and brazing. In untreated state: Ts, 75,000 psi; sp gr, 8.40; magnetic; resists corrosion caused by automotive combustion gases. Used for spark plugs and electrode wire.

Grade A: Ni 80, Cr 20. Rod, bars, wire and strip. Used for electric heating elements to 2100 F.

Grade C: Ni 60, Cr 16, balance mainly Fe. Castings, rods, bars and strip. Used for electric heating elements to 1800 F; also for rheostatic purposes.

Grade D: Ni 35, Cr 18½, balance mainly Fe. Wire, rod and strip. Used for heating elements in furnaces where certain atmospheres exist.

CHROMEND (DC arc welding electrodes) — Arcos Corp., Philadelphia 43, Pa.

Chrome-nickel and straight chrome coated rods for joining stainless steels and straight chromium irons.

CHROME-VANADIUM (Alloy tool steel) — Vanadium-Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

Types D, G, H, K, N and BB, with analyses of C 0.50-1.00, Si 0.25, Mn 0.30, Cr 0.80-1.20 and V 0.20. Rough bars or billets, finished rods or bars, wire, sheet, plate, forgings and drill rod, for precision casting, machining, hot and cold working, stamping, drawing and brazing. Water or oil-quench, depending upon carbon content, 1425-1550 F; temper 300-1300 F. Rock hdns, C55-67 max, depending on carbon content. Magnetic; weldability, fair; max cont serv temp, 300-500 F. For bearings and high grade machine parts.

CHROMOLLOY (Welding electrodes) — McKay Co., The, Pittsburgh, Pa.

A: Cr 1.0, Mo 0.05. Low alloy steel arc welding electrode for welding high pressure piping and alloy steels. Properties (stress relieved): Ts, 85,000 psi; ys, 70,000 psi; elong in 2 in., 23%. All position deep penetrating electrode for DC. AWS E8010.

B: Cr 2.0, Mo 1.0. Low alloy steel arc welding electrode for welding high pressure piping and alloy steels. All position deep penetrating electrode for DC.

C: Cr 1.0, Mo 0.50. Low alloy steel arc welding electrode for welding high pressure piping and alloy steels. Properties (stress relieved): Ts, 88,000 psi; ys, 83,000 psi; elong in 2 in., 25%. Low hydrogen coating. For AC.

D: Cr 2.0, Mo 1.0. Low alloy steel arc welding electrode for welding high pressure piping and alloy steels. Low hydrogen coating. For AC.

CIBANITE (Plastics molding powder)—Ciba Co. Inc., New York 14.

Aniline formaldehyde resin, thermoplastic.

Powder form for molding. Abrasion-resistant; resists corrosion caused by alkalies; max cont serv temp, 247 F; flexibility, low; dielectric strength, 400-600 (volts per mil inst); ts, 8200 psi; comp str, 24,000 psi; moisture absorp, 0.01-0.08%; natural brown color; impact str, 0.30 ft lb; sp gr, 1.22-1.25; translucent; machinability, good. For use where good strength with electrical properties are required, such as for stator insulation, tube bases, coil forms, terminal boards, strips and blocks.

CIMET (Chromium - nickel steel castings) — Driver-Harris Co., Harrison, N. J.

Ni 10-12, Cr 26-28, and Fe balance. Castings for high-temperature furnace parts.

CIRCLE L (Casting steels) — Lebanon Steel Foundry, Lebanon, Pa.

A series of wear, corrosion and heat-resistant, and stainless steel alloys in casting form, used especially for chemical and general processing equipment. Properties of the various grades are as follows: (Composition gives essential elements other than iron)

CARBON STEELS:

A: C 0.4, Mn 0.7. Ts, 85,000 psi; bhn, 170; for steel castings.

B: C 0.25, Si 0.40, Mn 0.65. Ts, 65,000; bhn, 135; for steel castings.

LOW-ALLOY STRUCTURAL STEELS:

No. 3: C 0.40, Cr 1.00, Mo 0.25, Mn 0.70. Ts, 110,000 psi; bhn, 200-300. For straightening dies, cams, gears, hot pressing and light forging dies.

No. 7: C 0.07, Mn 0.25, Si 0.6. Ts, 48,000 psi; bhn, 120. For electrical parts.

No. 8: C 0.15, Cr 2.40, Mo 1.00. Ts, 70,000 psi; bhn 150. For temperatures up to 1050 F.

No. 9: C 0.20, Mn 0.65, Mo 0.5. Ts, 65,000 psi; bhn, 135. For turbines, valves and fittings.

No. 10: C 0.15, Cr 5.50, Mo 0.50. Ts, 90,000 psi; bhn, 200. For oil still parts.

No. 19: C 0.15, Ni 2.75. Ts, 70,000 psi; bhn, 150. For pumps and fittings for sub-zero service.

No. 91: C 0.15, Cr 9.00, Mo 1.00. Sand castings to specification. Properties, heat-treated: Ts, 90,000 psi; ys, 60,000 psi; elong in 2 in., 18%; bhn, 200; sp gr, 7.80; magnetic; machinability, good; weldability, fair; max cont serv temp, 1150 F.

No. 209: C 0.20 max, Cr 1.25, Mo 0.50. Sand castings to specification. Properties, heat-treated: Ts, 50,000 psi; ys, 55,000 psi; elong in 2 in., 22%; bhn, 150; sp gr, 7.80; magnetic; machinability, good; weldability, good; max cont serv temp, 1000 F.

No. 205A: C 0.3, Si 0.4, Mn 0.8, Ni 0.6, Cr 0.6, Mo 0.20. Ts, 85,000 psi; bhn, 185. For steel castings.

No. 205B: C 0.30, Si 0.4, Mn 0.8, Ni 0.6, Cr 0.6, Mo 0.2. Ts, 105,000 psi; bhn, 225. For steel castings.

No. 205C: C 0.30, Si 0.4, Mn 0.8, Ni 0.6, Cr 0.6, Mo 0.2. Ts, 120,000 psi; bhn, 260. For steel castings of high physical properties.

No. 205D: C 0.30, Si 0.4, Mn 0.8, Cr 0.6, Ni 0.6, Mo 0.2. Ts, 150,000 psi; bhn, 320. For castings of superior physical properties.

No. 296: C 0.15, Mn 0.8, Cr 0.6, Ni 0.6, Mo 0.2. For castings to be carburized.

STAINLESS STEELS:

No. 11: C 0.25, Cr 19.0. Ts, 100,000 psi; bhn, 200. For valves and chemical apparatus.

No. 12: C 0.10, Cr 12.0, Ni 0.50. Ts, 110,000 psi; bhn, 220. For chemical apparatus.

No. 12M: C 0.10, Cr 13.0, Se 0.25. Ts, 85,000 psi; bhn, 170. For chemical apparatus.

No. 13: C 0.25, Cr 13.0, Ni 0.50. Ts, 200,000 psi; bhn, 500. For chemical apparatus and valve trim.

No. 14: C 0.25, Cr 21.0, Cu 1.0, Ni 0.50. Ts, 90,000 psi; bhn, 200. For exhaust manifolds, boiler tube hangers.

No. 15: C 0.30, Cr 28.0, Ni 3.0. Ts, 60,000 psi; bhn 190. For heat and corrosion-resistant parts.

No. 19-9-DL: C 0.30, Cr 19.00, Ni 9.00, Mo, W, Cb, Ti. Sand castings to specification. Properties, heat-treated: Ts, 90,000 psi; ys, 40,000 psi; elong in 2 in., 20%; bhn, 165; sp gr, 7.90; nonmagnetic; max cont serv temp, 1350 F. For gas turbines and jet engines.

No. 21: C 0.08 max, Cr 19.50, Ni 10.50, Cb 0.80. Ts, 80,000 psi; bhn, 145. For stainless and corrosion-resistant parts and weldments.

No. 22: C 0.08 max, Cr 19.50, Ni 9.0. Ts, 75,000 psi; bhn, 135. For corrosion-resistant chemical and extreme low - temperature equipment.

No. 22M: C 0.08 max, Cr 19.5, Ni 9.0, Se 0.25. Ts, 80,000 psi; bhn, 160. For free-machining stainless parts.

No. 22XM: C 0.08 max, Cr 19.5, Ni 9.0, Mo 2.5. Ts, 82,000 psi; bhn, 170. For highly corrosion-resistant parts.

No. 23: C 0.20 max, Cr 18.00-21.00, Ni 8.00-11.00. Sand castings to specification. Properties, heat-treated: Ts, 75,000 psi; ys, 36,000 psi; elong in 2 in., 45%; bhn, 140; sp gr, 7.80; nonmagnetic (slightly magnetic when cold worked); machinability, fair; weldability, good.

No. 30: C 0.20 max, Cr 24.5, Ni 13.5. Ts, 85,000 psi; bhn, 165. For heat and corrosion-resistant parts.

No. 30XM: C 0.20 max, Cr 24.5, Ni 13.5, Mo 3. Ts, 85,000 psi; bhn, 170. For use as parts for paper mill equipment.

No. 31: C 0.25, Ni 9.0, Cr 28.0. Ts, 83,000 psi; bhn, 170. For equipment to resist severe acids and acid fumes.

No. 32: C 0.50, Ni 35.0, Cr 15.0. Ts, 70,000 psi; bhn, 150. For heat-resistant castings.

No. 33: C 0.07, Cr 19.5, Ni 23.5, also molybdenum, copper and silicon. Ts, 72,000 psi; bhn, 150. For castings for sulphuric acid service.

No. 34: C 0.70, max, Cr 20.0, Ni 30.0, also molybdenum, copper and silicon. Ts, 72,000 psi; bhn, 150. For parts resistant to H_2SO_4.

No. 41: C 0.50, Cr 17.0, Ni 66.5. Ts, 75,000 psi; bhn, 160. For heat-resistant parts.

No. 46: C 0.20, Cr 25.0, Ni 20.0. Ts, 70,000 psi; bhn, 130. For heat-resistant parts.

"16-25-6": C 0.12 max, Cr 16.0, Ni 25.0, Mo 6.0. For heat resistant applications in aviation engines.

CLEARSEAL (Vinyl resin coating)—Arco Chemical Products Corp., Long Valley, N. J.

Vinyl resin applied to fabric and paper, also other synthetic rubbers and covers; both thermosetting and thermoplastic. Sheet and laminated form. For molding, sewing and cementing. Abrasion resistance, high (for fabric); resists corrosion caused by acids, alkalis, salts and gasoline; max cont serv temp 250 F; flexibility, high (or changed as desired); moisture absorp, may be varied as required; any color. For machine covers, diaphragms, bellows, oil or grease retaining jackets, etc.

CLETALOY (Spot welding electrodes)—Cleveland Tungsten Inc., Cleveland.

Copper-tungsten type electrodes for spot welding. Available in four grades with high specific gravity.

CT-A: Predominantly tungsten. Rock hdns, B92-97; electrical conductivity about 38 per cent that of pure copper. In addition to spot welding, it works well as crimper die insert for finish turning edge of steel jacket to form a seal for the porcelain stem in spark plugs.

CT-65: Conductivity and tungsten similar to that of CT-A grade; Rock hdns, B84-91. For welding of thin stainless steel sheets, and in the upsetting of special steel which does not forge well, this grade supplies red hot surface which can withstand high pressure of small bar during knob forming process. This grade holds original hardness especially well.

CT-86: Higher electrical conductivity than other grades; Rock hdns, B77-83. Suitable for welding nonferrous metals and for applications where low pressures are sufficient.

LN-14: Silver-tungsten-base alloy for use in applications where it shows an advantage over copper, possibly having some connection with the fact that silver oxide which might form on surface is a better electrical conductor than copper oxide.

CLEVE-TUNG (Molybdenum)—Cleveland Tungsten Inc., Cleveland.

Mo 99.9 plus. Rough bars or billets, finished rods and bars, wire, sheet, plate, and powder metal. Properties cold-worked: Ts, 50,000 to 250,000 psi; nonmagnetic; weldability, fair; abrasion resistance, medium; max cont serv temp, 3000 F (protected atmosphere). For various electronic parts, etc.

CLEVE-TUNGSTEN (Tungsten) — Cleveland Tungsten Inc., Cleveland, O.

Tungsten rough bars or billets, finished rods and bars, wire, sheet, plate, and powder metal. For power tube parts. Rock hdns, C40-80; sp gr, 19.3; nonmagnetic; weldability, poor; resists acids and alkalies; max cont serv temp (protected atmosphere), 4500 F; abrasion resistance, high.

CLIDERITE (Thermoplastic potting material)—Ernst Bischoff Co. Inc., Plastics Div., Ivoryton, Conn.

Waxy plastic material meltable at temperatures above 300 F. Types 1 and 2A. Sp gr (solid, 77F), 0.97; ts, 650-1050 psi; elong at breakpoint, 4-10%; resists dilute acids and alkalies in general; resists concentrated alkalies and some concentrated mineral acids; readily attacked by concentrated organic acids and nitric acid. For sealing or insulating electrical connectors, rectifiers, batteries, etc.

COAST METALS (Casting alloys)—Coast Metals, Inc., Canton 6, O.

Nos. 1, 101, 104, 10, 110, 112, 15, 115, 18, 118, X, 100-X; Iron and nickel-base casting alloy sand, permanent-mold and precision castings to specification. Machinability, fair with carbide tools; weldability, good; all alloys have stainless properties; abrasion resistance, high. For parts subject to wear.

COAST METALS (Hard-facing rods) — Coast Metals, Inc., Canton 6, O.

No. 101 (No. 1 gas): Tough, file-hard. Good wear and abrasion resistance. High impact, nonmagnetic. Used on brick and clay machinery, agriculture and agriculture processing equipment, steel mill applications (cold).

No. 104 (No. 4 gas): Dense rod, highly resistant to abrasion. Acetylene deposits on cylindrical sections without checks. Magnetic; Rock hdns (single layer), C55-60. For shafting, centerless grinder rests, cams, gauge blocks.

No. 112: Hard, tough. Harder than No. 101. Rock hdns, C52-57. Abrasion resistance, outstanding; nonmagnetic. For digger teeth, jaw crushers, bucket lips, cement mill machinery, hammer mills, excavating equipment, sand shot blast equipment.

No. 118 (No. 18 gas): High temperature properties. Withstands constant and repeated loads at high temperature. Machinable with carbide tools. Slightly magnetic. For steam valves, hot dies, punches, pump sleeves, soaking pit tong bits.

No. 110 (No. 10 gas): Hard. Moderate high-temperature properties; nonmagnetic; Rock hdns, (single layer), C48-56. Large steel mill guides, hot slag handling, coke plant equipment and stripper tong bits.

No. 115 (No. 15 gas): Hard, tough, excellent welding characteristics and high temperature properties. Rock hdns (single layer), C53-58. Slightly magnetic. For sprocket teeth on elevators operating at high temperature; valve ends and cams; mixer rolls.

No. 100X (No. X gas): Forgeable, tough, magnetic. Specially developed for hot shears.

COHRLASTIC (Silicone rubber)—The Connecticut Hard Rubber Co., New Haven, Conn.

Sheet and strip. Abrasion resistance, medium; chemical resistance, good except for aromatics and concentrated acids and alkalies; max cont serv temp, -70 to 300-500 F; inflammable at 1000-1500 F; flexibility, high; dielectric str, 550-1100 (volts per mil inst); moisture absorp, low; in white, opaque shatterproof. For resilient gaskets and tapes when heat resistance and/or high dielectric strength over the entire temperature range are required.

Cohrlastic 10631: White silicone rubber meets all requirements of AMS 3302. Good elongation, tear, strength and abrasion resistance. For gasketing or molded parts in high or low-temperature applications.

Cohrlastic 10321: Gray silicone rubber meets all requirements of AMS 3304. Low compression set and excellent dielectric properties. For gaskets, molded parts, and extrusions.

Cohrlastic 10325 and 10620: White silicone rubbers meeting all requirements of AMS 3305. Cohrlastic 10620 remains flexible at temperatures below -100 F, while Cohrlastic 10325 has better compression set. For gaskets, molded parts, and seals in applications requiring a high durometer material.

Cohrlastic 1R18: Molded Cohrlastic 10319 reinforced with 1 ply of 164 fiberglas, complying with requirements of AMS 3320. For diaphragms and gaskets. Has excellent service as fire walls, tank linings, etc.

Cohrlastic 10470: Low density silicone sponge rubber resistant to high and low temperatures meeting requirements of CHR466 specification. For gasketing, vibration damping, fairing strips, and seals.

COLMONOY (Hard facing welding rod)—Wall Colmonoy Corp., Detroit 3.

No. 1: Cr 7-11, B 1-2, Si 2-4 and Fe balance. Welding electrode; Rock hdns, C 58-62; sp gr, 7.70; weldability, fair. For hard-facing various parts of high manganese steel such as dipper teeth, scraper blades, etc., agricultural equipment.

No. 4: Ni 75-85, Cr 8-14, B, Fe, Si and C 8 max. Cast welding rod and powder; Rock hdns, C 35-40; sp gr, 8.22; nonmagnetic; weldability, good; resists corrosion caused by all alkalies and acids except hydrochloric; max cont serv temp, 1500 F; abrasion resistance, medium.

No. 5: Ni 71-81, Cr 10-17 B, Fe, Si and

C 9 max. Cast welding rod and powder; Rock hdns, C 45-50; sp gr, 8.14; nonmagnetic; weldability, good; resists corrosion caused by all alkalies and acids except hydrochloric; max cont serv temp, 1500 F; abrasion resistance, high. For parts subject to wear and corrosion, but which must be hard-faced with a machinable alloy, such as sleeves, auto and diesel valves, steam valves, pump sleeves, pump plungers, etc.

No. 6: Ni 71-81, Cr 10-17, and B, Fe, Si and C 9 max. Cast welding rod (powder metal or plastic rod). Rock hdns, C 56-62; sp gr, 7.80; nonmagnetic; weldability, excellent; resists corrosion caused by all alkalies and acids except hydrochloric; max cont serv temp, 1500 F; abrasion resistance, high. For shaft sleeves and plungers, steam valve trim, centers, centerless grinder rests, cams, gages, sprockets, seal rings, etc.

No. WCR 100: Cr 13-19, B 2.75-4, W 17-22, and Fe balance. Finished rods or bars for gas welding. Rock hdns, C 65-68; sp gr, 8.40; nonmagnetic; weldability, good; abrasion resistance, high. Excellent for cutting tools used on aluminum and magnesium.

Sweat-on Paste: For gas welding and carbon arcing. Parts hard-faced with paste may be heat-treated without harm to overlay. Rock hdns, C 68-72; sp gr, 3.30; abrasion resistance, high. For tractor grousers and sprockets, coal chutes, fan blades, sand scraper blades and other foundry equipment subject to severe wear such as dipper teeth, bucket lips, etc.

COLMONOY NICROBRAZ (Brazing alloy)—Wall Colmonoy Corp., Detroit 2.

Ni-Cr heat and corrosion resistant brazing alloy for brazing stainless steels. Joint properties: Ts (at 2000 F), 98.9% of base metal.

COLONIAL (Alloy tool steels) — Vanadium-Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

Two types in rough bars or billets, finished rods or bars, wire, sheet, plate, forgings and drill rods.

No. 14: C 1.00, Si 0.25, Mn 0.25. Properties heat-treated: Rock hdns, C 65-67; abrasion resistance, low.

No. 7: C 1.00, Si 0.25, Mn 0.25, V 0.20. Properties heat-treated: Rock hdns, C 65-67; max cont serv temp, 300-500 F; abrasion resistance, medium; bearing qualities, good.

COLONIAL (Ceramics)—The Colonial Insulator Co., Akron, O.

Ceramic specialties for the electrical and chemical industries. Porcelain forms for dipped rubber and plastic products.

COLORSTRIP (Colored strip steel)—Acme Steel Co., Chicago 8, Ill.

Strip steel in coils, electro-galvanized or plain and coated on one or both sides with any specific color (coating may be either enamel or lacquer). Fabricated by rolling or stamping; corrosion-resistant; max cont serv temp, 150 F; same tensile strength, elongation and hardness as standard strip steel with slight variations depending on temper and analysis of base metal.

COLUMBIA STEEL SHAFTING—Columbia Steel & Shafting Co., Pittsburgh 30, Pa.

Cold finished steel bars and shafting; drawn, turned and polished, ground and polished. Standard and special shapes. All standard AISI grades in carbon and alloy steel.

COMMERCIAL (Steel castings) — Commercial Steel Casting Co., Marion, O.

Steel castings to special specification and to ASTM, Army or Navy, American Bureau of Shipping and Maritime Commission Specification.

COMMONWEALTH (Steel castings) — General Steel Castings Corp., Granite City, Ill. and Eddystone, Pa.

Produced to specification of ASTM, AAR, Federal, Bureau of Shipping, Navy, etc. also carbon low and medium alloy steel castings to proprietary specifications. For railroad devices, heavy industrial machinery, pumps, etc.

COMPAR (Elastomer)—Resistoflex Corp., Belleville, N. J.

Compounded, modified polyvinyl alcohol base material: Sheets, rods and tubes and hose. Solvent and abrasion resistance, high; max cont serv temp, 250 F; flexibility, high; ts, 2500-5200 psi; moisture absorp, medium; sp gr, 1.26. For flexible hose connections and assemblies for low and medium pressure hydraulic systems, lubricating, refrigeration, air conditioning, fuel, industrial spray finishing and solvent handling systems. Gaskets, diaphragms and molded parts.

COMPO (Porous bronze)—Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.

H: Cu 89, Sn 9.75, graphite 1.25. Oil-retaining porous bronze bearings. Furnished in completed parts via powder metallurgy. Impregnated with 23% of lubricant by volume. Ts, 14,700 psi; Rock hdns, H30-70. For oil-less bearings in machines.

3H: Cu 89, Sn 9.75, graphite 1.25. Oil-retaining porous bronze bearings. Furnished in completed powder metal parts. Impregnated with 27% of lubricant by volume. Ts, 12,000 psi; Rock hdns, H25-50. For oil-less bearings in all types of machines.

R: Cu 87, Sn 9.5, graphite 3.5. Porous bronze bearings and washers containing higher percentage of graphite. Porous structure contains to 15% oil developed particularly for antiscuffing under heavy vibrating static loads; also heavy oscillating loads. Ts, 15,000 psi; comp str, 75,000 psi.

F: Cu 85, Sn 9.5, graphite 5.5. Oil retaining porous bronze bearings. Furnished in completed powder metal parts. For seals, seal rings, seal thrust washers in pumps, compressors, etc.

CONDULOY (Beryllium copper) — The Brush Beryllium Co., Cleveland.

Be 0.35: Ni 1.5, Cu balance. Rough bars or billets. Heat-treated: Ts, 85-100,000 psi; ys, 70-80,000 psi; elong in 2 in., 4-13%; Rock hdns, B90-100; nonmagnetic; weldability, fair; max cont serv temp, 700-800 F; resists corrosion about same as pure copper. For resistance welding electrodes, welding wheels, circuit breakers, etc., and brake drums.

Beryllium Copper Alloy No. 6: Be 2.5, Ni 1.1, Cu balance. Rough bars or billets. Heat treated: Ts, 150-180,000 psi; ys, 110-140,000 psi; elong in 2 in., 1-3%; Rock hdns, C 38-44; nonmagnetic; weldability, fair; abrasion resistance, high; resists corrosion about same as pure copper; max cont serv temp, 400-500 F. For bearings, bushings, and high-strength, high-hardness parts in general.

CONGO (High-speed tool steel)—Braeburn Alloy Steel Corp., Braeburn, Pa.

C 0.78, Cr 4.00, W 4.00, Mo 5.00, Co 12.00, V 1.40. Rough bars or billets, finished rods or bars. Recommended heat treatment: 2180 F, oil quench; 1050 F draw. Heat-treated hardness, Rockwell C 64-66; high abrasion resistance. For various cutting and forming tools.

CONPERNIK (Iron-nickel magnetic alloy) — Westinghouse Electric Corp., East Pittsburgh, Pa.

Ni 49.5, Fe 49.5 and Mn .01. Constant permeability over limited ranges of flux variations; available in punchings and finished cores, continuous cold-rolled strip and hot-rolled sheets. Makes possible choke coils having a high ratio of inductive-to-resistance components.

CONSOWELD (Thermosetting laminated plastics)—Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.

Melamine decorative laminates: Maximum size 4′ x 16′. Available in over 40 colors and patterns including Linens, Cascades, Pearls and Woodgrains. Max cont serv temp, 275 F. Used for kitchen cabinet and sink work surfaces, shower stalls, wall surfacing, table tops, bar and soda fountain tops.

Phenolic laminates: Properties (industrial grades): Ts, 36,000 psi; dielectric strength, 550 volts per mil; sp gr 1.35 1.40; machinability good; Large sizes up to 8′ x 16′. Uses: truck floors, pattern plates, refrigerators breaker strips, electrical panels, punch stock, pasting boards for tanneries, and tooling stock.

CONTINENTAL (Alloy steels) — Continental Foundry & Machine Co., East Chicago, Ind.

C-1: Seven grades ranging from 0.20-0.80 carbon content; plain carbon steels.

C-2: C-Mn-Ni-Mo cast steel for parts requiring special physical properties such as tractor frames, locomotive castings, power shovel castings, locomotive crane castings, and other machinery parts

C-3: C-Mn-Mo cast steel requiring special properties such as sprockets, spindles, gears, miscellaneous castings for power shovels, locomotive cranes, locomotive wheel centers and crossheads, and other parts.

C-4: C-Mn-Mo-V cast steel for pinions, axles and spindles, and other parts subject to severe service.

C-5: C-Ni-Mo cast steel for forging machinery and hammer parts, rams and sow blocks.

C-6: C, High Cr-Mo cast steel for special abrasive qualities suitable for various types mills, crushers, etc.

C-7: C-Cr-Ni-Mo cast steel designed for machinery or other parts subjected to severe wear, strength and impact service.

C-10: C-Cr-Mo cast steel for forging dies, tools, etc. All of the above steels are heat-treated to give desired properties.

"Chrome-Molybdenum": Cr-Mo alloyed steel rolling mill rolls for blooming, bar, billet, structural and merchant mills, also backing-up rolls for strip mills.

"Heat-Treated Alloy": Cr-Ni-Mo rolling mill rolls for billet, blooming, merchant and bar mills.

Special: Ni-Cr alloyed steel for rolling mill rolls for use in billet, bar, structural and merchant mills where resistance to wear is prime factor.

CONTINENTAL (Mechanical rubber)—Continental Rubber Works, Erie, Pa.

Molded, extruded and lathe-cut mechanical rubber products including hose, fan belts, and all types of industrial rubber goods.

CONTINENTAL (Copper-steel sheet)—Continental Steel Corp., Kokomo, Ind.

Sheets. Resist corrosion; uniform temper; good workability. Sizes: Gage, 10 to 30; width, 48 in. max; length, 144 in. max depending on gage.

COOPER ALLOYS (Metal alloy castings)—The Cooper Alloy Foundry Co., Hillside, N. J.

Stainless steels, pure nickel and Monel castings to specification. Used primarily for combatting corrosion, heat and abrasion.

COPPERWELD (Copper-covered steel)—Copperweld Steel Co., Glassport, Pa.

Copper-covered steel in wire, strand, or rods, with copper exterior permanently welded (cast) to the steel core. Resists rust and corrosion; provides adequate electrical conductivity for many electrical uses and rust-resisting high strength for many mechanical uses.

CORDIERITE (Ceramics)—General Ceramics & Steatite Corp., Keasbey, N. J.

Sheet, rods or tubes, and plates. Abrasion resistance, low; resists acids and weak alkalies, except hydrofluoric acid. Max cont serv temp, 2200 F; nonflammable; trans str, 8500 psi; moisture absorp, low; sp gr, 2.38; in light tan; opaque. For use where high heat shock resistant ceramic material is required.

CORNING (Glasses) — Corning Glass Works, Corning, N. Y.

In general, glasses with coef thermal exp'n. above 50 x 10^{-7}/°C. Blown, drawn, pressed products with wide range of chemical, physical, optical, electrical and mechanical properties.

CO-RO-FELT (Needled sisal pads)—Columbian Rope Co., Auburn, N. Y.

Sheets for impregnating with phenolic base resin. For molding into parts. Properties, after molding: Abrasion resistance, high; max cont serv temp, 350 F; flexibility, medium; ts, 11,000 psi; inflammable; can be highly polished; opaque; can be produced in color. For cams, gears, bobbin heads, bearings, tension and compression members, etc.

CRAMP'S Superstrength Bronze (Bronze)—Baldwin Locomotive Works, Philadelphia 42, Pa.

Composition conforms to ASTM B-147. Ingots and sand castings. Properties, unheat-treated: Ts, 90-125,000 psi; ys, 45-95,000 psi; elong in 2 in., 8-25%; bhn, 185-240; abrasion resistance, medium. For castings or forgings subject to high compressive loads and shock. Not recommended for high contact speeds.

CRASFLOY (Hard iron alloy) — Continental Foundry & Machine Co., East Chicago, Ind. and Pittsburgh, Pa.

Hard alloy grain iron rolling mill rolls made in four grades: Mild, medium, hard and super hard for rolling hot and cold strip, sheets and plate.

CRESCENT (Solder)—Crescent Smelting Works, Inc., Brooklyn 6, N. Y.

Bars, strips and wire for soldering lead, brass, copper, black and galvanized sheet metal and stainless steels.

CROLITE (Steatite and other ceramics) — Henry L. Crowley & Co., West Orange, N. J.

Steatite and other ceramics, suitable mainly as electrical insulation and particularly the critical insulation for high-frequency radio applications.

CROLOY (High perm metal)—Henry L. Crowley and Co., West Orange, N. J.

For horizontal output and deflection yokes for TV and other applications.

CROMANSIL (Arc welding electrode)—Metal & Thermit Corp., New York 5.

For main drive shafts, automotive springs,

jib crane parts, etc. Weld deposit: Ts, 77-111,000 psi; ys, 65-102,000 psi; elong in 2 in., 14-26%.

Type E-43: Al 92.5-94, Si 4.5 to 6. Arc welding electrode for aluminum sheet, castings, shapes or extruded forms, As, 14,000 psi, min.

Type FHP: For machine frames and bases, diesel exhaust manifolds, hoists and other heavy weldments. Weld deposit: Ts, 62-70,000 psi; ys, 52-58,000 psi; elong in 2 in., 25-31%.

CROMONITE (Hard iron alloy) — Continental Foundry & Machine Co., East Chicago, Ind. and Pittsburgh, Pa.

Hard alloy chill roll in four grades: Mild, medium, hard and super hard for hot and cold strip rolling.

CROWLEY (Powder metal)—Henry L. Crowley & Co., West Orange, N. J.

Powder metal parts such as bearings, filters, formed pieces, etc.

CRUCIBLE (Stainless steels)—Crucible Steel Co. of America, New York.

Standard stainless steels of AISI type. For type, application and characteristic data see "Stainless Steels" listed at end of this section.

CRUCIBLE #4615 (Carburizing steel)—Crucible Steel Co. of America, New York.

AISI No. 4615. Core properties (reheated to 1475 F and quenched in oil): Ts, 105,000 psi; ys (offset 0.2%), 60,000 psi; elong in 2 in., 27%; reduction of area, 59%; bhn, 217. For bearing cups, chain pins, construction gears, rolls, differential ring gears, etc.

CUMBERLAND (Turned and ground mild steels)—Cumberland Steel Co., Cumberland, Md.

Turned and ground steel rods to AISI spec's C 1020, C 1040 and C 1141. For precision shafting, studs, tie rods, etc.

CUNICO (Permanent-magnet alloy)—Carboloy Co., Detroit, Mich.

Alloy of copper, nickel and cobalt, made from rod, strip or wire stock, furnished in finished shapes, age-hardened. Malleable, ductile and machinable, permitting manufacture of small magnet screws and punchings of intricate shapes.

Cunico can also be obtained from The Arnold Engrg. Co., Marengo, Ill.

CUNIFE (Permanent-magnet copper-nickel-iron alloy) — Carboloy Co., Detroit, Mich.

Magnets of wire stock in round, square or rectangular form. Wire can be flattened to make thin, narrow shapes. Wide variety of magnet designs can be obtained by forming, drawing, punching, or machining.

Cunife can also be obtained from the Arnold Engrg. Co., Marengo, Ill.

CUPALOY (Copper base alloy)—Cadman, A. W., Mfg. Co., Pittsburgh, licensed by Westinghouse Electric Corp.

Available as sand castings, rods, and strips. Physical properties: Elastic limit, 35-40,000 psi; ys, 60-65,000 psi; ult str., 65-75,000 psi; elong., 17%; reduction in area, 60%; Rock hdns, 80-85B; coef of expn, 16.5 x 10.6; softening temp., 450-500 C; electrical conductivity, 80-90; thermal conductivity, 80-90. Properties (as cast): Ys, 35,000 psi; ult str, 47-50,000 psi; elong, 25-30% reduction in area, 60%; bhn, 100-125; fat. str., 20-22,000 psi. For rolls for seam welding machines, resistance welding electrodes, slip rings, coils, conductors, brush holders, terminal studs, trolley wheels and gliders, contacts, springs of all types, fuse clips, electrical upsetting rivets, etc.

CUPRODIE (Alloy steel)—A. Finkl & Sons Co., Chicago, Ill.

0.50-carbon, Cr-Ni-Mo-Cu steel for die blocks, inserts, and bars. Heat-treated to various tempers, all commercially machinable to 477 bhn. For drop hammer dies and inserts, also forging machine dies.

CUPRON (Copper-nickel alloys) — Wilbur B. Driver Co., Newark, N. J.

Cu 55, Ni 45. Rough bars or billets, finished rods or bars, wire and coiled strips. Properties (untreated): Ts, 62,000 psi; elong (hard), 2%; (soft), 40%; sp gr, 8.9; nonmagnetic; weldability, good; max cont serv temp, 1500 F. For electrical uses.

CUSH-N-FIT (Sponge rubber)—Davidson Rubber Co., Boston 29, Mass.

Molded in a variety of forms and shapes. For insulating, sound deadening, moisture-resistance, sealing, vibration reduction, etc. Material: Natural, GRS-natural, REC-natural, Neoprene, Buna-N or GRS.

CUTTRODE (Cutting electrode)—Eutectic Welding Alloys Corp., New York 13.

Coated rods for cutting all metals without use of special equipment or oxygen. Used in ordinary electrode holder; also for underwater cutting.

CUYO (Steels)—Cuyahoga Steel & Wire Co., The, Maple Heights, O.

Standard carbon and alloy steels in cold-drawn bars and wire.

DAIRYWHITE (Copper-nickel alloy) — Arthur Harris & Co., Chicago 7.

Cu 67, Ni 23, zinc, lead and tin, balance. For food machines, dairy machines, etc.

DAREX (Sealing compound)—Dewey & Almy Chemical Co., Cambridge 40, Mass.

Dispersions of rubber or synthetic resins which when deposited in a closure dry to form a gasket that becomes an integral part of the metal part. Supplied in fluid form; flowed into joint. For seals on all types of closures or for cushioning vibration.

DEFENDER (Babbitt)—Magnolia Metal Company, Elizabeth, N. J.

Strong, malleable alloy for use in place of most genuine babbitts in bearings subject to shock loads. 80% lead babbitt, copper-free; bhn, 19.5; ys, 7,685 psi; pouring temp, 850-900 F.

DELTA (Cadmium treated babbitt) — Randall Graphite Bearings Inc., Chicago 6.

For extremely heavy pressures, turbines, mining equipment, marine reciprocating engines, rolling mills, paper mill calender stacks. Properties: Ult str, 18,730 psi; ys, 9,270; bhn, 26.

DELTAMAX (Electrical Steel)—Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

A grain-oriented, high purity, 50% nickel-iron alloy characterized in its final heat-treated condition by the rectangular shape of its hysteresis loop. Used in magnetic amplifiers and saturable reactors.

Toroidal cores wound of Deltamax tape supplied by The Arnold Engineering Co., Marengo, Ill.

DENSEWOOD (Wood-base thermoplastics) — Densewood Corp., Elkhorn, Wis.

Wood-base, thermoplastic material for machining into parts. Abrasion resistance, medium; max cont serv temp, 350 F; flexibility, low; ts, 18,000 psi; comp str, 14,400 psi; moisture absorp, low; nonflammable; sp gr, 1.15; opaque; takes high polish. For pulleys, rollers, pushbuttons, etc.

DENS-TECH (Plywood)—Technical Ply-Woods, Chicago 1.

Thermosetting: Sheets for machining into parts. Abrasion resistance, good; resists corrosion, repels termites; heat resistance, good; bonded at 350 F; flexibility, medium to low depending on thickness; tensile and compr str, good to excellent depending on thickness; moisture resistance, excellent; machinability, good.

DEWARD (Oil-hardening tool steel)—Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

Oil-hardening tool steel: Suitable for intricate machine parts subject to wear without much shock. Hardens with very little size change. Hot-rolled, annealed bar stock, forged disks and rings, cold drawn or ground bars. Wide range of sizes carried in warehouse stocks.

D-H-S (Bronze)—Koppers Co. Inc., Metal Products Div., Baltimore 3, Md.

Rough bars or billets, finished rods or bars and sand castings.

D-H-S No. 2: Properties, unheat-treated: Ts, 115,000 psi; elong in 2 in., 12%; bhn, 225.

D-H-S No. 3: Properties, unheat-treated: Ts, 105,000 psi; elong in 2 in., 17%; bhn, 200.

D-H-S No. 4: Properties, unheat-treated: Ts, 90,000 psi; elong in 2 in., 25%; bhn, 185.

These alloys, combining ductility, hardness and strength with wear and shock resistance under heaviest loads, are recommended for worm gears, heavy-duty bearings, bolts and nuts, pressure-tight castings, valve bodies and seats, spur and bevel gears, needle-valve seats, etc.

DIAMITE (White iron castings) — Weatherly Foundry & Mfg. Co., Weatherly, Pa.

Low-silicon cast iron containing 4½% Ni and 1½% Cr. Sand castings to specification. Ts, 40,000 psi; bhn, 600-700; weldability, fair; abrasion resistance, high. For sand pumps, cement mill parts, grinding wheel molds and abrasion resistant castings.

Also Ni Hard and Ni Resist sand castings under license of International Nickel Co., Inc.

DIAMOND (Vulcanized fibre)—Continental-Diamond Fibre Co., Newark 23, Del.

Cellulose hydrate material in laminated sheets, rods, tubes and formed parts. Abrasion resistance, high; gasoline, kerosene, oil, grease and alcohol resistant; max cont serv temp, 220 F; flex str, 13,000 psi (ASTM D-229-42); dielectric str, 150 volts per mil inst; ts, 8000 psi; compr str, 30,000 psi; impact str (Izod), 5.5-8.9 ft-lb; arc resistance, 150 seconds; gray, white, black and red; moisture absorp, medium; sp gr, 1.1-1.4; opaque; bhn, 15. For electrical insulation, gaskets, water seals, bobbins, handles, housings and gears.

DICARB (Tungsten-carbide) — Firth-Sterling Steel and Carbide Corp., McKeesport, Pa.

Specially developed tungsten-carbide for the manufacture of blanking, coining or perforating dies and punches.

DIE-TECH (Plywood) — Technical Ply-Woods, Chicago 1.

Thermosetting: Sheets for machining into parts. Abrasion resistance, good; resists corrosion, repels termites; heat resistance, good; bonded at 350 F; flexibility, medium to low depending on thickness; tensile and compr str, good to excellent depending on thickness; moisture resistance depends on treatment; machinability, excellent.

DIEWELD (Welding rods and electrodes) — American Manganese Steel Div. American Brake Shoe Co., Chicago Heights, Ill.

C 1.0, Cr 3.5, Mo 2.3. Bhn, 500-550. Abrasion and impact resistance up to 800 F. For hardfacing only; martensitic steel deposits; magnetic; air hardening, responds to heat treatment; can be forged. For production of composite dies, shear knives, milling cutters, reamers, simple dies and molds, etc. Also for reclamation of worn shear knives, punches, and molds, upset and drop forging dies and tools, and for general hard facing.

DILECTO (Glass fabric-base plastic) — Continental-Diamond Fibre Co., Newark 23, Del.

Phenol formaldehyde thermosetting material in sheets, rods and tubes for compression molding. Abrasion resistance, high; gasoline, kerosene, oil, grease, alcohol and acid resistant. Max cont serv temp, 350 F; flex str, 21,000 psi (ASTM-D-229-42); dielectric str, 600 volts per mil inst; ts, 24,000 psi; compr str, 44,000 psi; impact str (Izod), 10 ft-lb; produced in natural color; moisture absorp, low; sp gr, 1.6; opaque. For electrical insulation, and hydraulic pressure hose or tubes.

DILECTO (Thermosetting plastics)—Continental-Diamond Fibre Co., Newark 23, Del.

Fabric base: Phenolic; thermosetting. Sheets, rods, tubes, and post-formed parts. Abrasion resistance, high; resistant to gasoline, kerosene, oil, grease, alcohol, acids and some alkalies. Max cont serv temp, 250 F; flex str, 21,000 psi (ASTM D-229-42); dielectric str, 700 volts per mil inst; moisture absorp, low; ts, 11,000 psi; tan and black; impact str (Izod), 3.5 ft-lb; takes high polish. For cams, bushings, nameplates, baffle plates, thrust washers, valve seats, bobbins, pulleys and spacers.

Paper base: Phenolic; thermosetting. Sheets, rods, tubes and post-formed or fabricated parts. Abrasion resistance, medium; resistant to gasoline, kerosene, oil, grease, alcohol, acids and some alkalies. Max cont serv temp, 250 F; flex str, 19,000 psi (ASTM D-229-42); dielectric str, 700 volts per mil inst; moisture absorp, low; ts, 12,000 psi; tan and black; impact str (Izod), 1.1 ft-lb; takes high polish. For electrical insulation, chemical pipe, guide rollers, handles, spacers, and guide plates.

Glass base: Silicone; thermosetting. Used where high temperature stability is necessary. Max cont serv temp, 400 F; flex str, 23,000 psi (ASTM D-229-42); dielectric str, 250 volts per mil inst; moisture absorp, 0.15; ts, 18,000 psi; impact str, (Izod), 12 ft-lb; natural cream color. Sheets, rods and tubes.

DISCALOY 24 (Nickel-chrome alloy)—Westinghouse Electric Corp., East Pittsburgh, Pa.

Ni 26, Cr 13, Mo 3, Ti 1.6, Fe 55. Disk forgings, bars or rods, etc. Nonmagnetic; resists corrosion; high creep strength and ductility in temp range of 1000-1350 F; guaranteed minimum ts, 150,000 psi; ys (0.2 offset), 85,000; elong in 2 in., 15%; reduction of area, 18%; 5% rupture elong at 1200 F and 60,000 psi test load. Primarily for bolting and disk material. Strength properties may be modified for other applications.

DM (Steel)—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, Ohio.

Carbon 0.15 max, Mn 0.3-0.6, Si 0.5-1, Cr 1-1.5, Mo 0.45-0.65, P 0.03 max, S 0.03 max. Rough bars or billets, finished rods

or bars and tubing, for hot forging, welding, turning, boring, etc., into parts. Max cont serv temp, 1100 F; ts, 60,000 psi min; ductility, medium; weldability, fair; bhn (annealed), 163 max. For oil refinery field and for superheater tubing.

DM-45 (Alloy steel)—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O.

C 0.4-0.5, Mn 0.4-0.7, Si 0.55-0.75, Cr 1.0-1.5, Mo 0.40-0.60. Rough bars or billets, and finished rods or bars, for hot forging, turning, boring, etc., into parts. Max cont serv temp, 1100 deg F; ts (heat-treated), 150,000 psi (min); ductility, medium; bhn (untreated), 185; (heat-treated), 411 max. For bolts, studs and other highly-stressed parts used at elevated temperatures.

DODGE (Composition cork) — Dodge Cork Co. Inc., Lancaster, Pa.

Sheets, strips, rods or tubes, plates and special shapes. Fabricated by die cutting, turning and sawing. Abrasion resistance, medium; nonflammable; flexibility, high; moisture absorp, medium. For gaskets, washers, bumpers, vibration dampers, friction drives, inserts, plugs and floats.

DODGE (Steel castings) — Dodge Steel Co., Tacony, Philadelphia.

Medium-Carbon Steel (SAE 1030): Heat-treated sand castings. Ts, 70,000 psi; ys, 35,000 psi; elong in 2 in., 24%; bhn, 143 min; magnetic; weldability, good; abrasion resistance, medium; max cont serv temp, 850 F. For machine parts subject to moderately high loads and impact; valves and fittings for steam, liquids and various gases; structural members, etc.

D-1 Manganese-Molybdenum Steel: Heat-treated sand castings. Ts, 80-170,000 psi; ys, 55-140,000 psi; elong in 2 in., 22-7.5%; bhn, 163-360; magnetic; weldability, fair (good when preheated); abrasion resistance, good (when fully hardened). For high-strength machine parts and those requiring wear resistance, and flame or induction hardening.

D-12 Low Carbon-Nickel Steel: Heat-treated castings. Ts, 70,000 psi; ys, 40,000 psi; bhn, 143; magnetic; weldability, good; abrasion resistance, medium; excellent low-temperature properties (15 ft-lb Charpy at —75 F). For structural and machine parts subject to impact loads at normal and low temperatures.

D2B: Chrome-molybdenum steel. C 0.20-0.28, Mn 0.50-0.70, Si 0.35-0.45, Cr 0.40-0.60, Mo 0.40-0.60. Sand castings to specification. Properties, heat-treated: Ts, 70,000 psi; ys, 45,000 psi; elong in 2 in., 22%; bhn, 143-160; machinability, good; weldability, good; max cont serv temp, 900 F; abrasion resistance, medium. Excellent creep properties; resists graphitization in elevated-temperature service. For high-temperature valves and fittings.

DOLER ALSILOY #1 (Aluminum die casting alloy)—Doehler-Jarvis Corp., New York 16.

Si, 12%. Ts, 40,000 psi; ys, 20,000 psi; elong in 2 in., 3%; impact (Charpy), 3 ft-lb; bhn, 75; sp gr, 2.66; nonmagnetic; resists atmospheric corrosion; max cont serv temp, 500 F; abrasion resistance, low. For general industrial parts such as for household utilities industries, optical, electrical, food containers, business machines, tools, etc.

DOLER ALSILOY #9 (Aluminum - base die-casting alloy) — Doehler-Jarvis Corp., New York 16.

Cu 3.5, Si 9, balance Al. Ts, 40,000 psi; ys, 25,000 psi; elong in 2 in., 2.5%; impact (Charpy), 3 ft-lb; bhn, 80; sp gr, 2.80; nonmagnetic; weldability, fair; resists atmospheric corrosion; max cont serv temp, 500 F; abrasion resistance, low. For electrical items, household utilities.

DOLER ALSILOY #10 (Aluminum - base die - casting alloy) — Doehler-Jarvis Co., New York 16.

Si 10, Mg 0.5, Al balance. Ts, 45,000 psi; ys, 27,000 psi; elong in 2 in., 4.5%; impact (Charpy), 5 ft-lb; bhn, 75; sp gr, 2.66; nonmagnetic; weldability, fair; resists atmospheric corrosion; max cont serv temp, 500 F; abrasion resistance, low. For die-cast machine parts requiring good tensile strength, high corrosion resistance and good electrical properties.

DOLER-BRASS (Brass die castings) — Doehler Jarvis Corp., New York 16.

Brass die castings. Composition suited to meet varying conditions. Ts, to 100,000 psi; bhn, to 180; corrosion resistance, excellent.

DOLER-MAG (Magnesium-base die castings)—Doehler Jarvis Corp., New York 16.

Die castings, one-third lighter than aluminum, to specification.

DOLER-ZINK (Zinc-base die castings)—Doehler Jarvis Corp., New York 16.

Zinc base die castings of high tensile and impact strength.

DO-LITE (Aluminum-base die castings)—Doehler-Jarvis Corp., New York 16.

Composition suited to meet stringent requirements such as high tensile strength, impact strength, hardness, corrosion resistance, thermal conductivity and electrical conductivity. Takes high polished luster.

DOW CORNING (Silicone fluids and greases)—Dow Corning Corp., Midland, Mich.

DC 200 Fluids: Crystal clear, inert liquids, notable for thermal stability and flat viscosity-temperature slopes. Useful in various viscosity grades at temperatures from —70 to 400 F., the Dow Corning 200 fluids have high flash and fire points with freezing points ranging from —58 to —123 F. In viscosity grades above 50 centistrokes, nonvolatile with negligible vapor pressure at temperatures up to 400 F; resistant to oxidation and to shear breakdown; highly water repellent; excellent dielectric properties. Good lubricants for rubber, plastics and various metal combinations. Available in viscosities from 0.65 to 1,000,000 centistokes. For viscous damping media, instrument and hydraulic fluids, antifoam and anti-silking additives, liquid dielectrics, water repellents, polishes for glass, furniture and automobiles.

DC 550 and 550R: Heat-stable silicone fluids with viscosities of 100-150 centistokes, a flat viscosity-temperature slope, high resistance to oxidation, low volatility and a flash point of 600 F. Do not gel or form gums even after heating in contact with air at 500 F for 1000 hours. Used as high temperature oil bath and lubricant for certain bearing metals at temperatures ranging from 40 to above 300 F. Dow Corning 550 and Dow Corning 550R, which contains a heat-stable rust inhibitor, are both used as permanent lubricants for instruments, clocks and other mechanical devices operating at high and low temperatures under light to moderate loads.

DC 710, 710R and 710G: Dow Corning 710 is a clear, straw colored silicone fluid with a viscosity in centistokes of 500 ±5% at 25 C a freezing point of —8 F and a flash point of 600 F. A heat-stable, inert and hydrophobic fluid that can be heated in contact with air at 500 F for over 1200 hours without gelling; good lubricating properties at temperatures from 10 to 500 F under medium to light loads; excellent weather and oxidation resistance and low volatility. Used as a high temperature hydraulic fluid, lubricant, or oil bath. Dow Corning 710R contains a rust inhibitor; Dow Corning 710G contains colloidal graphite in suspension and is serviceable at temperatures above 400 F. Both oils are used to lubricate oven conveyor bearings, tenter frames, dryers and machinery exposed to high temperatures, high humidity or weathering. Dow Corning 710R is used as a permanent lubricant for instruments and timing devices.

DC 702 and DC 703: Diffusion pump fluids stable to air and moisture at operating temperatures of 175 to 225 C. Pumping speeds in the range of 1 x 10^{-4} mm. of Hg are comparable to those of the best organic diffusion pump fluids. Under favorable conditions, DC 703 has created vacua of less than 1 x 10^{-7} mm. DC 702 will not produce quite as high a vacuum but it requires less power and operates against slightly higher fore pressures.

DC 1107 is a colorless, hydrophobic silicone product with a viscosity of 20-40 centistokes at 25 C. It is odorless and noncorrosive with an acid number of less than 0.1. Soluble in aliphatic and aromatic hydrocarbons, chlorinated solvents, ethyl acetate and methyl ethyl ketone, DC 1107 is insoluble in water but it can be emulsified with the proper emulsifying agents. Paper, properly treated with DC 1107, becomes highly water repellent and nonadhesive to rubber, asphalt, pressure sensitive tapes and to most other sticky materials.

DC 33 Grease. Designed for very low temperature applications, showing little tendency to bleed even at high temperatures. Torque at —100 F is about equal to that of most AN-G-25 organic greases at —75 F. Available in fluid, light medium or heavy consistency. Dow Corning 33 is serviceable from —100 to 300 F in ball bearings operating at speeds up to 70,000 rpm. It is used to lubricate gyro and small synchronous motor bearings, ball bearings exposed to severe outdoor weathering, cameras and other optical instruments.

DC 41 Grease: Used in antifriction bearings operating at speeds up to 2000 rpm and at —20 to 400 F and upward. Nonmelting and highly resistant to water, to oxidation and to the fumes of most chemicals, Dow Corning 41 is used to lubricate oven conveyor bearings, low speed oven machinery and pumps handling hot liquids.

DC 44 Grease: So resistant to oxidation that pressure loss is only 1.5 pounds after 500 hours exposure to oxygen at 210 F in the Norma-Hoffman bomb test. Even at 390 F bleed and evaporation are low. Available in fluid, light, medium or heavy consistency, Dow Corning 44 is serviceable at speeds up to 20,000 rpm and at temperatures from —40 to 350 F.

DC Valve Seal A: Solidification point below —50 F and no true melting point, this silicone grease is generally effective in flow meter bearings and valves operating at temperatures from —65 to 500 F and in contact with hot water, air and most gases, steam, aqueous solutions, dilute and some concentrated acids and alkalies, vegetable and mineral oils. Also used in the packing of pumps handling corrosive materials.

DC: Smooth and translucent dielectric paste with an unworked penetration of 240 to 260. It retains its grease-like consistency after long exposure to temperatures from —70 to 400 F. It is highly resistant to oxygen, ozone, hydrogen peroxide and to deterioration caused by corona discharge. It is more water repellent than paraffin or waxes.

DC 7: Heat-stable and oxidation resistant release agent for porous or rubber molds and for rubber bags or blankets used in low pressure laminating. It has no harmful effect on metals or plastics and it is practically inert physiologically. "Permaslip" is a form of Dow Corning 7 used as a release agent for heat sealing equipment.

DOW CORNING (Silicone resin)—Dow Corning Corp., Midland, Mich.

DC 2103: Thermosetting silicone resin supplied as a 60% solution in toluene with a viscosity of 60-100 centipoises at 25 C. It is used to bond inorganic fabrics in the production of rigid electrical laminates and for bonding finely divided particles such as powdered metals or mica. Properties typical ⅛ inch silicone-glass laminates: Flex str, 22,000 psi; water absorp (24 hours), 0.25%; dielectric str (continuous filament cloth) 250 volts/mil or more; power factor, 0.002 at 1 mc; loss factor, 0.007 at 1 mc; wet insulation resistance, more than 10^{12} ohms; arc resistance, 300 seconds; heat distortion value, above 250 C.

DOW CORNING DC 993 and DC 996 (Electrical insulation)—Dow Corning Co., Midland, Mich.

DC 993 Varnish: Semi-inorganic electrical insulating varnish available at either 50% or 70% resin solids content in toluene and xylene. Tack-free drying time is 1-3 hours at 250 C. Dielectric strength measured with 2 inch electrodes on films baked for 16 hours at 250 C is 1000-2000 volts/mil, and 500-1500 volts/mil, wet. Heat endurance is more than 100 hours and craze life is more than 1000 hours at 250 C. DC 993: soluble in aromatic, chlorinated or ester type solvents and aliphatic hydrocarbons; insoluble in water, alcohol, acetone or petroleum oils. Cured films have good resistance to dilute acids, concentrated hydrochloric and dilute or concentrated alkalies. DC 993 is used to bond and saturate Class H components including silicone-mica-glass combinations, and to impregnate Class H electrical equipment.

DC 996 Varnish: Class H electrical insulating varnish containing 50% silicone resin solids by weight in toluene and xylene. Tack-free drying time is 1-3 hours at 150 C. Dielectric strength measured with 2 inch electrodes on films baked for 16 hours at 150 C is 1000-2000 volts/mil, and 500-1500 volts/mil, wet. Heat endurance is more than 100 hours and craze life is more than 500 hours at 250 C. DC 996 is soluble in aromatic, chlorinated or estertype solvents and aliphatic hydrocarbons; insoluble in water, alcohol, acetone or petroleum oils. Cured films have good resistance to dilute acids, concentrated hydrochloric acid and dilute or concentrated alkalies. DC 996 is used to impregnate electrical equipment and to coat fibrous glass cloth, cord and sleeving or asbestos paper and cloth. Class H insulation made with Dow Corning Silicones is at least 10 times the life and 10 times the wet insulation resistance of the best insulating materials previously available.

DOWMETAL (Magnesium alloys) — The Dow Chemical Co., Midland, Mich.

Magnesium alloy ingots, castings, wrought forms, rods, bars, sheets, shapes, extrusions, sand ard die castings; also magnesium metal ingots, and magnesium metal sticks. Available in various types:

C: Al 9, Mn 0.1, Zn 2, remainder Mg. Ingots, sand and permanent mold castings. Ts, 40,000 psi; comp str, 60,000 psi; ys, 16,000 psi; elong, 10%; impact resistance, high; high elastic resilience; sp gr, 1.82; non-

magnetic; resists corrosion caused by caustic chromic acid, hydrofluoric atmospheres, etc. For reciprocating parts and housings.

FS 1: Al 3, Mn 0.3, Zn 1, remainder Mg. Rough bars or billets, finished rods or bars, tubing, sheets, coiled strips, plates; for extruding, rolling, drawing and pressing. Ts, 40,000 psi; ys, 30,000 psi; comp str, 50,000 psi; elong, 16%; sp gr 1.77; nonmagnetic; high elastic resilience. For aircraft parts and other applications requiring light weight.

H: Al 6, Mn 0.2, Zn 3, remainder Mg. Ingots, sand and permanent mold castings. Ts, 40,000 psi; ys, 14,000 psi; comp str, 46,000 psi; elong, 12%; impact resistance, high; high elastic resilience; sp gr, 1.83; resists corrosion caused by caustic, chromic acid, hydrofluoric atmospheres, etc. For aircraft parts and other applications requiring light weight.

JI: Al 6.5, Mn 0.2, Zn 1, remainder Mg. Rough bars or billets, finished rods or bars, tubing and shapes, for hot forging and extruding. Ts, 45,000 psi; ys, 32,000 psi; comp str, 69,000 psi; elong, 15%; sp gr, 1.8; nonmagnetic; high elastic resilience. For structural parts and fabricated housings.

M: Mn 1.5, remainder Mg. For sand castings, hot forging, rolling, drawing and pressing. In rolled state: Ts, 37,000 psi; ys, 29,000 psi; elong, 8%; impact resistance, high; sp gr, 1.76; nonmagnetic; weldability, good; max cont serv temp, 400 F; high elastic resilience. For parts requiring best combination of formability and weldability of magnesium alloys.

O1: Al 8.5, Mn 0.2, Zn 0.5, remainder Mg. Rough bars or billets, finished rods or bars and tubing; for hot forging and extruding. Properties, heat-treated: Ts, 50,000 psi; comp str, 75,000 psi; elong, 5%; impact resistance, high; endurance limit (completely reversed bending), 16,000 psi; sp gr, 1.8; nonmagnetic; high elastic resilience. For structural parts requiring maximum strength.

R: Al 9, Mn 0.2, Zn 0.6, remainder Mg: Ingots, sand, permanent mold and die casting. Properties, unheat-treated: Ts, 33,000 psi; ys, 22,000 psi; elong, 3%; impact resistance, high; sp gr, 1.81; abrasion resistance, medium; nonmagnetic. For die-cast housings and structural parts.

DRAPER (Felt)—Draper Bros. Co., Canton, Mass.

Woven wool felt in sheet, strip and belt. For filters, seals, wipers, etc.

DRAWALLOY (Welding electrodes) — Welding Equipment & Supply Co., Detroit 7.

Coated chrome-nickel-manganese-molybdenum alloy. For repairing forging, drawing and forming dies; also for creating bearing surfaces. Joint: Ts, 125,000 psi.

DUC-TEN (Alloy steel castings)—Electric Steel Castings Co., Speedway, Indianapolis 24, Ind.

Wide variety of alloy steel castings including castings produced to specifications of ASTM, AAR and SAE.

DUFELT (Felt laminated with Neoprene)—The Felters Co., Boston.

Available in any desired combination of thicknesses or lamination arrangements. Corrosion-resistant. Used for washers and strips for oil and grease retention where operating conditions are too severe for use of plain felt. Petroleum-resistant.

DULL-COAT (Copper-steel sheet)—Continental Steel Corp., Kokomo, Ind.

Sheets. Durable. Takes paints, enamels and lacquers. Sizes: Gage, 14 to 28; width, 48 in. max; length, 144 in. max depending on gage.

DUNBAR (Industrial glass) — Dunbar Glass Corp., Dunbar, W. Va.

Glass cylinders in Lime glass and custom mold service in Lime and Borosilicote glasses.

Properties of Lime glass: Linear coef. of exp'n, 0.95 x 10^{-5} cm/cm/°C; sp gr, 2.464; refractive index, 1.512; softening temp (by Interferometer), 1008 F; annealing temp., 950 F; strain pt, 900 F; mod of rupture, 7,500 psi; electrical resistance under oil, avg. puncture at 315 volts per mil; chemical stability, slightly less than Borosilicate glass.

Properties of Borosilicate glass: Linear coef. of exp'n, 0.34 x 10^{-5} cm/cm/°C; sp gr, 2.256; refractive index, 1.476; strain pt, 932 F; mod of rupture, 10,000 psi; electrical resistance under oil, avg. puncture at 400 volts per mil.; chemical stability, dissolves 0.0035 grams per cm^2 in 17% NaOH for 100 hours at 50 C. Resists all acids except hydrofluoric and glacial phosphoric.

DUOLITE (Laminated safety window glass)—Pittsburgh Plate Glass Co., Pittsburgh 19.

Vinyl plastics binder; in flat and bent sheets. Corrosion and abrasion resistance, high; heat resistant to 180 F; flexibility, low; moisture absorp, low; nonflammable; shatterproof; transparent; highly polished. For windows which need not be optically perfect.

DUPLATE (Laminated safety plate glass) — Pittsburgh Plate Glass Co., Pittsburgh 19.

Laminated plate glass and vinyl plastics binder, in flat and bent sheets. Corrosion and abrasion resistance, high; heat-resistant to 180 F; flexibility, low; moisture absorp, low; nonflammable; shatter-resistant; transparent; highly polished. For shatter-resistant windows, including those of high optical quality.

DURALON (Furane - base plastics) — United States Stoneware Co., Akron 9.

Thermoplastic: For casting, machining, surface coating or laminating. Abrasion resistance, high; resists corrosion caused by chemical or solvent action; max cont serv temp, 400 F; flexibility, medium; dielectric str, over 5000 volts per mil; moisture absorp, low; produced in black; shatterproof with certain fillers and in certain shapes; sp gr, 1.1; opaque; machinability, good; Rock hdns, M110 (depending on cure); soluble in nothing after cure except strong oxidizing acids. For light metal stamping dies, solvent proof coatings, cast electrical insulating parts, etc.

DURALOY (Chromium steel)—The Duraloy Co., Scottdale, Pa.

Alloy CA: Cr 11-14, C 0.15 max. Sand castings, sheets, plates and centrifugally cast tubes. Fabricated by machining and welding. For pump parts such as valves.

Alloy CB: Cr 18-22, C 0.30 max. Sand castings, sheets, plates, and centrifugally cast tubing. Fabricated by machining, bending and forming, arc welding and gas welding. Max cont serv temp, 1450 F. For special valves, impellers, etc., high temperature service in the chemicals and food processing industries.

Alloy CC: Cr 26-30, Ni 4.00 max, C 0.50 max. Sand castings, sheets, plates, and centrifugally cast tubes. Fabricated by machining and welding. Max cont serv temp, 2100 F; resistance to sulphur atmospheres, high. For high-temperature applications.

Alloys H and H2: Cr 17-28, high carbon. Sand castings. Max cont serv temp, 1450 F; abrasion resistance, high. For roll guides, crusher plates, glass molds and plungers, abrasive conveying systems.

Alloy CE: Cr 17-21, Ni 9-13. Sand castings, sheets, bars, and centrifugally cast tubing. Ts, heat-treated, 75,000 psi; ys, 40,000 psi; elong in 2 in., 50%; weldability, good; max cont serv temp, 1550 F. For pump parts, pipe and fittings, autoclaves and digesters, textile specialties, mixing kettles.

Alloy HH: Cr 23-28, Ni 9-13. Finished rods or bars, sand castings, sheets, plates, centrifugally cast tubing. Fabricated by machining, bending and forming, arc and gas welding. Ts, 70,000 psi; ys, 45,000 psi; elong in 2 in., 15%; max cont serv temp, 2100 F. For furnace parts, salt pots, trays for heat treating, belt conveyors, oil still parts, radiant burner tubes.

Alloy HT: Cr 13-17, Ni 34-37. Finished rods or bars, tubing, sand castings, sheets, plates, and centrifugally cast tubing. Fabricated by machining, bending and forming, arc and gas welding. Ts, 60,000 psi; ys, 35,000 psi; elong in 2 in., 5%; max cont serv temp, 2100 F. For retorts, trays, carburizing equipment, furnace parts, radiant burner assemblies.

Alloy HW: Cr 15-19, Ni 64-68. Sand castings and centrifugally cast tubing. For retorts, muffles, carburizing trays and fixtures, cyanide pots, etc.

DURAMAL (Pearlitic malleable iron)—Webster Mfg. Inc., Tiffin, O.

Sand castings to specification. Ts, 70,000 psi; ys, 50,000 psi; elong in 2 in., 10%; bhn, 180; weldability, fair; abrasion resistance, medium. For high strength conveyor chain, abrasion resistant conveyor buckets, high strength agricultural castings, etc.

DURASHIELD (Cellulose acetate plastics) — Plastic Fabricators Inc., San Francisco 11.

Thermoplastics: Any size, shape, thickness or color specified; can be die cut and punched. Abrasion resistance, low; resists corrosion caused by salt spray and moisture; heat resistant to 170 F; flexibility, high; shatterproof; moisture absorp, low; transparent, translucent and opaque.

DURCO (Cast alloy steels)—Duriron Co., Inc., Dayton, O.

Alloy steels (18-8S, 18-8SMO, etc.): Cr 18, Ni 8, C 0.07 max, and other standards as well as special analyses. For pumps, valves, fittings, and castings for corrosive service.

DUREX (Powder metals) — Moraine Products Div., General Motors Corp., Dayton, Ohio.

Products of powder metallurgy in iron, bronze and other metals; self-lubricating bearings and various small parts for electric motors, instruments, aircraft, appliances, automotive equipment, farm equipment, washing machines, etc.

DUREZ (Thermosetting phenolic plastics)—Durez Plastics & Chemicals Inc., North Tonawanda, N. Y.

Molding powders; phenolic base, thermosetting. Corrosion-resistant; highly polished; moisture absorp, low; cont serv temp, 350-550 F; ts, 4000-7000 psi; in colors; shock and abrasion resistant. For housings, handles, bases, knobs, electrical parts, small gears, frames, hoods, etc.

Liquid resin (No. 7421A). Cast at room temperatures. Compr str, 15,000-20,000 psi; impact str, 0.11-0.15 ft lb (Izod); flex str, 7000-9000 psi.

DURICHLOR (High silicon iron)—Duriron Co., Inc., Dayton, O.

Si 14.5, Mo 3, C 0.90, Mn 1, traces of P and S, balance Fe. For pumps, valves, pipe, and castings for corrosive service, especially for hydrochloric acid and chloride solutions.

DURIMET 20 (Stainless cast steels)—Duriron Co., Inc., Dayton, O.

Ni 29, Cr 19, Si 1, Cu 3.5, Mo 2.5, C 0.07 max, balance Fe. For pumps, valves and castings for corrosive service, especially hot, weak sulphuric acid. Available in wrought forms from Carpenter Steel Co. as Carpenter Stainless 20. Also licensed to other foundries, known as Misco 20, Uti.oy 20, etc.

DURIRON (High silicon iron) —Duriron Co., Inc., Dayton, O., and licensees.

Si 14.50, C 0.8, Mn 0.6, S and P traces, balance Fe. For pumps, valves, exhaust fans, mixing nozzles and castings for handling acids and other corrosive liquids and gases.

DURITE (Thermosetting plastic)—The Borden Co., Chemical Division, New York 17.

Phenol formaldehyde and phenol furfural thermosetting plastics in powder form for compression and transfer molding. Abrasion resistance, medium; resistance to weak alkalies and acids, good; max cont serv temp, 250-450 F; flex str (ASTM D 48-43T), 8-11,000 psi; dielectric str (volts per mil inst.) 175-460; ts, 5000-7500 psi; compr str, 15-35,000 psi; in black and brown; moisture absorp, low; sp gr, 1.32-1.95; opaque; machinability, fair. For ignition parts, automotive parts, housings, fuse blocks, handwheels, pulleys, handles, etc.

DURITE (Cast steel)—Hanford Foundry Co., San Bernardino, Calif.

High carbon, nickel, chrome, molybdenum alloy steel sand castings. Properties, heat-treated: Ts, 180,000 psi; ys, 160,000 psi; resistance, high; wear resistance, excellent. For ball and rod mill liners, cement mixers, etc.

DURODI (Alloy steel)—A. Finkl & Sons Co., Chicago 14, Ill.

A 0.50 carbon, Cr-Ni-Mo alloy steel furnished in inserts, bars and shaped pieces; heat-treated to various tempers, all commercially machinable; also annealed for hadening in oil or in air blast. For forging machine dies, inserts and mandrels and forging dies.

DURONZE ALLOY (High-copper silicon bronzes)—Bridgeport Brass Co., Bridgeport, Conn.

High Cu-Si bronzes alloyed with elements such as Sn, Al, etc. Possess high strength combined with corrosion resistance.

Silicon Eronze 813: Cu 97.6, Sn 1.4, Si 1.0. Excellent cold working properties. For cold-headed bolts and screws. Average ts, 100,000 psi in rod, wire and sheet form.

Silicon Bronze 632: Cu 97, Si 3. Sheet, rod, wire, and tubing. Hot-rolled sheet for range boilers, automatic heaters, and storage tanks by either electric-arc or oxyacetylene welding methods. Cold-rolled strip used as substitute for phosphor-bronze spring metal; rod and wire for making hot-headed bolts and screw products.

Silicon Bronze 609: Cu 98, Si 2. Wire for making difficult cold-headed parts; also screws, bolts, rod, tubing, and sheet. Malleable; good corrosion resistance; ts, about 100,000 psi. For cold headed products.

Duronze III: Silicon-aluminum bronze. Cu 91, Al 7, Si 2. Rod form only. Ts, 85,000-100,000 psi. Free-machining for making screw machine parts; also for sucker rods for corrosive oil wells. 10% lighter than brass. Excellent corrosion resistance. In ingot form may be used for making sand castings with ts about 70,000 psi. For compression fittings for oil and gas lines in air-

plane construction, small gears, screws, pinions, oil burner nozzles, nuts, valves and valve stems, bonnets, etc.

Duronze IV: Cu 95, Al 5, plus Arsenic. Made into condenser tubes for resisting corrosion from aerated sea water mixed with fresh water and acid wastes, sewage, etc., often found in harbors. Also for hot brine solutions in salt refining.

DUSTCOTE (Welding rod)—Harnischfeger Corp., Milwaukee 14, Wis.

Mild steel welding rods for joining structural steels. Ts of joints, 55-60,000 psi; ys, 40-45,000 psi. For applications requiring stable arc with little spatter and welds that are easily cleaned.

DUTCH BOY (Babbitt metal) — National Lead Co., New York 6.

Analysis of material varies according to the bearing application.

DYNALLOY (Alloy steel)—Alan Wood Steel Co. Conshohocken, Pa.

Sheets, strips, and plates, for stamping welding, cold and hot forming, etc.; abrasion resistance, medium; ts, 65-80,000 psi; ductility, high; weldability, good; fatigue and impact values, high. For structures requiring high strength.

D-Z-L GENUINE (Babbitt) — Magnolia Metal Company, Elizabeth, N. J.

Highest grade of genuine babbitt for very heavy duty bearings subject to extreme combinations of heavy pressure, high temperature and severe shock. 88% tin, lead-free; bhn, 29.6; ys, 9,610 psi; pouring temp, 925-1000 F.

E-1 to E-15 (Powder metal)—Powered Metal Products Corp. of America, Franklin Park, Ill.

Pressed and sintered parts of powder metal having high iron content. Material has high Q and permeability values, is suitable for high and low frequency coils, permeability tuning, transformers, etc.

EIS 45 (Chrome steel)—Heppenstall Co., Pittsburgh.

C 0.85, Cr 12. For hot forgings into parts. For shear blades for shearing medium heavy material.

EIS 57 (Nickel-chrome-molybdenum steel)—Heppenstall Co., Pittsburgh.

C 0.6. For insert and hot die steel service.

E-70 (Powder metal)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

Pressed and sintered parts of 99% pure iron metal powder. Ts, 30,000 psi; machinability, good. High electrical properties, for electrical pole pieces and armatures.

EASTERN (Cast ferrous metals)—The Eastern Malleable Iron Co., Naugatuck, Conn.

Eastern "2": Replaces unalloyed steel castings or forgings. M-10: Ts, 65,000 psi; ys, 45,000 psi; elong in 2 in., 10%; bhn, 163-212; pattern shrinkage ⅛ in. per ft. M15: Ts, 75,-000; ys, 50,000 psi; elong in 2 in., 8%; bhn, 170-223; pattern shrinkage ⅛ in. per ft. M16: Ts, 85,000; ys, 55,000 psi; elong in 2 in., 6%; bhn, 187-235; pattern shrinkage, ⅛ in. per ft. All types have good machinability, wear and abrasion resistance. They can be welded.

Eastern Hy-Tenso: Ts, 75,000 psi; ys, 50,000 psi; elong in 2 in., 3-7%; bhn, 200 avg; pattern shrinkage, ⅛ in. per ft; machinability, fair; weldability, good; wear, corrosion and abrasion resistant; high polish. For caster plates, caster forks, caster wheels, cams and shafts, chain links, crank shafts, gears, brake bands, etc.

Eastern Hy-Tenso X: Ts, 53,000 psi; ys, 35,-000 psi; elong in 2 in., 18%; bhn, 130 avg; pattern shrinkage, ⅛ in. per ft; machinability, fair; corrosion resistant; high polish. For fire escapes and outdoor stairways.

Eastern Hy-Tenso xw: An adaptation of Hy-Tenso X with the added feature of an abrasive material cast in the surface. For non-slip applications.

Eastern H-65: Ts, 65,000 psi; elong in 2 in., 0%; bhn, 300 avg; pattern shrinkage, 11/64 in. per ft; machinability, poor; weldable; not too corrosion resistant; wear, abrasion, and shock resistance, good; high polish. For die blocks, stoker parts, low heat resisting castings, etc.

Eastern H-60: Ts, 60,000 psi; elong in 2 in., 0%; bhn, 270 avg; pattern shrinkage, 11/64 in. per ft; machinability, fair; weldable; no appreciable corrosion resistance; wear, abrasion and shock resistance, good; high polish. For pressure castings and fittings, cylinders, rolls, low temperature pistons, large gears, etc.

Eastern H-55: Ts, 55,000 psi; elong in 2 in., 0%; bhn, 270 avg; pattern shrinkage, 11/64 in. per ft; machinability, fair. For lapping planes, typewriter bars, small rolls, pressure fittings, close grain castings stronger than commercial grey irons.

Eastern G-40: Ts, 40,000 psi; elong in 2 in., 0%; bhn, 240 avg; pattern shrinkage, ⅛ in. per ft; machinability, fair; weldable; no appreciable corrosion resistance; wear, shock and abrasion resistance, good; high polish. For castings requiring machining subject to temperatures to 1200 F.

Eastern G-35: Ts, 35,000 psi; elong in 2 in. 0%; bhn, 215 min; pattern shrinkage, ⅛ in. per ft; machines easier than G-40; abrasion, shock and wear resistance less than G-40. For pressure fittings, wearing parts requiring machining, cams to be hardened, close grained castings stronger than commercial grey irons.

EASTERN (Nickel-chrome alloys)—The Eastern Malleable Iron Co., Naugatuck, Conn.

Eastern N: Cr 16.0. Ts, 50,000 psi min; ys 50,000 psi min; elong. in 2 in., 0.50%; bhn (annealed), 195 avg; pattern shrinkage, 5/16 in. per ft; not machinable; not recommended for welding; corrosion resistant; high polish. For low alloy carburizing boxes, low alloy annealing boxes, recuperator parts, grate bars, furnace parts, etc.

Eastern N-1: Cr 28.0, Ni 12.0. Ts, 75,000 psi min; ys, 60,000 psi min; elong in 2 in., 2%; bhn, 260 avg; pattern shrinkage 5/16 in. per ft; not machinable; weldable; corrosion resistant; high polish. For furnace parts, pump parts for hot oil, etc.

Eastern N-2: Cr 28.0. Ts, 50,000 psi min; ys 40,000 psi min; elong. in 2 in., 1%; bhn, 225 avg; pattern shrinkage, 5/16 in. per ft; machinability, hard; weldability, satisfactory; corrosion resistant; high polish. For annealing boxes, lead pots, pump and valve bodies, pyrometer tubes, etc.

Eastern N-3: Cr 23.0. Ts, 65,000 psi min; ys, 50,000 psi min; elong in 2 in., 1%; bhn, 220-260; pattern shrinkage 9/32 in. per ft; machinability, fair; weldable; corrosion resistant; high polish. For bottle machine plungers, chemical equipment.

Eastern N-4: Cr 20.0, Ni 66.0. Ts, 60,000 psi min; ys, 45,000 psi min; elong in 2 in., 2%; bhn, 250 avg; pattern shrinkage 5/16 in. per ft; machinability, hard; weldability, satisfactory; corrosion resistant; high polish. For carburizing containers, chemical reaction chambers, welding nozzles, pyrometer tubes, etc.

Eastern N-5: Cr 18.0, Ni 36.0. Ts, 65,000 psi min; ys, 45,000 psi min; elong in 2 in., 4%; bhn, 235 avg; pattern shrinkage, 5/16 in. per ft; machinability, hard; weldability, satisfactory; corrosion resistant; high polish. For furnace parts such as grids, hearth plates, rollers, chains, containers, etc.

Eastern N-6: Cr 7.0, Ni 22.0. Ts, 75,000 psi min; ys, 40,000 psi min; elong in 2 in., 20.0%; bhn, 160 avg; pattern shrinkage 5/16 in. per ft; machinability, fair; weldability, satisfactory; corrosion resistant; high polish. For ship propellers, pump and valve bodies, valve seats, furnace grids and trays.

Eastern 29-9: Cr 29.0, Ni 9.0. Ts, 97,000 psi min; ys, 49,000 psi. min; elong in 2 in., 28%; Rock hdns, 90-95B; machinability, fair; weldable; corrosion resistant; high polish. Can be used where 18-8 steel is now used.

EASY-FLO (Brazing rods)—Handy & Harman, New York 7.

Ag 50, Cu 15.5, Zn 16.5, Cd 18. Brazing alloy: Flows at 1175 F. Corrosion resistance, good; sp gr, 9.49. For brazing ferrous and nonferrous metals, particularly dissimilar metals and Monel metal, stainless steel and other copper-nickel and chrome-nickel alloys. Many electrical uses.

No. 3: For fabrication of large copper piping, etc., and joining cemented carbide tool tips to holders.

No. 35: Ag 35, Cu 26, Zn 21, Cd 18. Coiled strip, wire and sheet. Sp gr, 9.06; nonmagnetic. For ferrous, nonferrous and dissimilar metals which can be heated to flowing temp of 1295 F. Melts at 1125 F.

No 45: Ag 45, Cu 15, Zn 16, Cd 24. Coiled strip, wire and sheet for brazing. Properties, cold-worked: Sp gr, 9.34; nonmagnetic. To join ferrous, nonferrous and dissmilar metals that can be heated to 1145 F. Flows fast and spreads rapidly.

EASY REAM (Bronze)—National Formetal Co. Inc., Cleveland 14, O.

Cu 89, Pb 1.5, Si 0.5, Zn 9. Coiled strip. Properties, cold-worked: Ts, 45-50,000 psi; ys, 40-45,000 psi; elong in 2 in., 25-30%; Rock hdns, B45-55; nonmagnetic; machinability, good; weldability, fair. For spindle and king-pin bushings, rocker-arm bushings, brake and clutch-pedal bushings, etc.

E. C. (Plastic)—Sandee Manufacturing Co., Chicago 30.

Ethyl cellulose plastic rods, tubes and special shapes. Resists inorganic acids and alkalies in low concentrations. Flex str, 4000-11,000 psi; dielectric str, 500-700 (volts per mil inst); ts, 5000-8500 psi; imp str (Izod), 2-8 ft-lb per inch of notch; moisture absorp, low; sp gr, 1.09-1.17; transparent, translucent and opaque; machinability, good; coef thermal exp'n, 10-20 x 10^{-5} inch/inch/degree C. For knobs, spacers, washers, drain and coolant tubing, etc.

ECLIPSE (Seamless flexible metal hose)—Metal Hose Dept., Bendix Aviation Corp., Teterboro, N. J.

85/15 bronze, 3% silicon bronze, 1010 steel, Monel, stainless steel and other alloys. Resists corrosion by salt water, ammonia, steam, gases, etc. Ductility, high.

ECONOMO 17 (Carbon steel)—Wheelock, Lovejoy & Co. Inc., Cambridge 39, Mass.

Carbon steel conforming to AISI C-1117. Rough bars or billets and finished rods or bars. Machinability, good; weldability, good. For shafts, spindles, gears, etc.

ECONOMY HARDFACE (Welding rods and electrodes)—American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

C 1.0, Cr 5.0, Mo 1.7, Bhn, 500-600. Abrasion and impact resistant up to 600 F. For hardfacing only; martensitic steel deposits; nonmagnetic. Self-hardening; high abrasion and severe impact resistance; responds to heat treatment; can be forged. For hardfacing quarrying, excavating, mining, construction, and steel mill wearing parts.

EEL-SLIP (Composite material) — Johns-Manville, New York 16.

Asbestos fiber, graphite and rubber compound. Heat-resistant; ts, high; nonflammable. For bearings, suction box covers, etc.

ELASTI-GLASS (Thermoplastic plastics) — S. Buchsbaum & Co., Chicago 16.

Vinylidene chloride copolymers and vinyl chloride acetate copolymers. Sheets, rolls, film, and extruded rods or shapes; also for compression molding and extruding into parts. Chemically resistant to almost all solvents. Dielectric str, high, all colors; moisture absorp, low. For diaphragms, valve seats, protective covers, etc.

ELASTO-RIB (Vibration damping material)—The Korfund Co. Inc., Long Island City 1, N. Y.

Vibration controlling material generally placed under machine footings. Consists of layer of cork between two layers of deep-grooved, high-grade rubber. 1-in. thick and available in pads of any area required. Recommended loading range in between minimum of 1000 and maximum of 2500 pounds per square foot.

ELASTRON (Flexible plastics)—Industrial Synthetics Corp., Garwood, N. J.

Polyvinyl family. Glossy to smooth dull finishes for stamping, embossing and printing; many colors; transparent, translucent or opaque; exceptionally tough; flexible; light weight; nonflammable; inert to alcohol or oil splashes, salt-water proof. For bumpers for household appliances, and various industrial applications.

ELASTUF (Alloy steels)—Horace T. Potts Co., Philadelphia 34.

Type A-2: Heat-treated and stress relieved special Cr-V with small controlled amounts of Ni and Mo; hot rolled. Further heat treating after machining not recommended. Ts (up to 2 in.), 125-145,000 psi; ys, 115-135,000 psi; elong in 2 in., 18-22%; reduction of area, 50-60%. Uniform hardness and strength throughout cross-sections of all sizes; good heat and wear resistance.

Type "44": Heat-treated and stress relieved. Special analysis including Cr, Ni and Mo; hot rolled. Ts, (up to 2 in.), 190-220,000 psi; ys, 175-200,000 psi; elong in 2 in., 10-17%; reduction of area, 38-50%. Machinable at approx. Rock hdns C44.

Type JJ Soft Steel: C 0.18-0.23 (improved analysis soft steel). Hot-rolled bars. Properties, unheat-treated: Ts, (up to 2 in.), 60-70,000 psi, ys, 35-45,000 psi; elong in 2 in., 25-35%; reduction of area, 50-60%; weldability, good. For all soft steel uses; excellent for forging, welding, bending.

Chro-moly (heat treated): Heat-treated alloy steel of good tensile properties, high impact strength and shock resistance, excellent creep characteristics. Ts, (up to 2 in.), 130-150,-000 psi; ys, 110-125,000 psi; elong in 2 in., 18-22%; reduction of area, 50-60%. For axles, heavy-duty, high-temperature and high-pressure bolts, etc.

Media: Precision Finish: Analysis same as AISI C-1040 and SAE 1040. Finished bars (turned, ground and polished). Ts (up to 2 in.), 90-105,000 psi; ys, 75-90,000 psi;

elong in 2 in., 10-20%; reduction of area, 35-50%; good weldability and machinability. For use where accuracy to size and straightness is needed.

Hot-Rolled: Analysis same as AISI C 1045 and SAE 1045. Hot-rolled bars. Ts (up to 2 in.), 80-95,000 psi; ys, 45-60,000 psi; elong in 2 in., 15-25%; reduction of area, 30-45%; weldability and machinability, good.

Penn Hot-rolled. Approx 0.45 carbon, special analysis. Ts (up to 2 in.), 100-125,000 psi; ys, 60-75,000 psi; elong in 2 in., 15-25%; reduction of area, 30-45%; weldability, good; machining qualities, good.

Cold-Finished Penn: Approx 0.45 carbon, special analysis. Ts (up to 2 in.), 110-135,000 psi; ys, 100-115,000 psi; elong in 2 in., 12-22%; reduction of area, 35-50%; weldability, good; same quality as Hot-Rolled with better machinability and higher tensile properties in cold-drawn sizes (up to 3 in. dia.).

Strainfree Penn Cold-Finished: Approx 0.45 carbon, special analysis. Finished bars, Ts (up to 1 in.), 125-145,000 psi; ys, 110-120,000 psi; elong in 2 in., 10-20%; reduction of area, 30-45%; weldability, good; specially processed to give tensile properties equal to many heat-treated alloy steels. Free from warping in machining. For lead and feed screws and miscellaneous machine parts.

ELECTRAPANE (Glass with electrical conducting film)—Libbey-Owens-Ford Glass Co., Toledo, O.

Sheet and plate. Abrasion resistance high; chemical resistance, same as regular glass; nonflammable; flexibility, medium; not shatterproof but stronger than untempered glass; transparent. For electrostatic dissipation, de-icing, and other uses subject to investigation.

ELECTROMET (Alloying elements) — Electro Metallurgical Division, Union Carbide and Carbon Corp., New York 17, N. Y.

Ferro-alloys and metals including alloys of boron, calcium, chromium, columbium, manganese, silicon, titanium, tungsten, vanadium, and zirconium.

ELECTRUNITE (Electric welded steel tubing)—Steel and Tubes Div., Republic Steel Corp., Cleveland 8.

Stainless, carbon and various alloy steels. Square, rectangular, oval, or other shapes. Any size or gage where periphery of shape is not less than 2 1/32 in. or more than 16 in. Following analyses: SAE 1010-1035, S630, 4130 and stainless steels Types 302, 304, 309S, 316, 317, 321, 347, 430 and 446. Other analyses available for specific applications. For general mechanical, structural, aircraft, conduit, boiler, condenser, heat exchanger and other pressure applications. For data on properties, characteristics and applications for stainless steels see "Stainless Steels" listing at end of this section.

ELEMITE (Ceramics)—The Louthan Mfg. Co., East Liverpool, O.

Five types of Cordierite refractory, two types of vitrified porcelain, three types of steatite, three types of zircon, and five types of porous refractories. Rods or tubes and special shapes. Refractories offer low thermal expansion, high resistance to heat shock, excellent electrical properties. Steatite offers low loss, high mechanical strength, close tolerances. Porcelains offer high dielectric strength. Zircon offers high strength, high refractoriness, and good resistance to thermal shock.

ELEPHANT BRAND (Phosphor bronzes and nickel silvers)—The Phosphor Bronze Corp., Seymour, Conn.

Following forms of phosphor bronze:

Strip and sheet in coils or lengths, various tempers, plain or tinned, 36 B&S (0.005-in.) to bridge plates.

Wire: Spring or other tempers, 32 B&S (0.0079) to ¾-in. diam. Coils or straightened lengths.

Rods: Complete range of sizes and alloys. 0.010-in. to 4¾-in. diam.; hex., ⅛ to 2 5/16-in.; squares, ¼ to 2¼-in. Also in many rectangular and special shapes.

Following nickel silver alloys:

Alloy No. 5: Cu 61, Zn 34, Ni 5. Wire in spring temper. Ts, 135,000 psi; elong in 2 in., 2%; electrical conductivity (IACS), 12%.

Alloy No. 10A1: Cu 67, Zn 23, Ni 10. Sheet, wire and rod in spring temper, ts, 109,000 psi; elong in 2 in., 1.5%; Rock hdns, B 88; sp gr, 8.64; electrical resistivity (IACS), 11.1; electrical conductivity (IACS), 9%.

Alloy No. 12X1: Cu 61, Zn 26, Ni 12, Pb 1. Rod only. Hard drawn temper, ts, 90,000 psi; elong in 2 in., 5%; Rock hdns, B 87.

Alloy No. 15A: Cu 64, Zn 21, Ni 15; in spring temper, ts, 93,000 psi; elong in 2 in., 5%; Rock hdns, B 90; sp gr, 8.70; electrical resistivity (IACS), 15.9; electrical conductivity (IACS), 6.3%; furnished in sheet, wire and rod.

Alloy No. 15X1: Rods. Cu 60, Zn 24, Ni 15, Pb1; in hard drawn temper, ts, 85,000 psi; elong in 2 in., 10%; Rock hdns, B 80; electrical resistivity (IACS), 16.7; electrical conductivity (IACS) 6%.

Alloy No. 18A4: Sheet and wire form. Cu Zn 17, Ni 18; in half-hard temper, ts, 70,000 psi; elong in 2 in., 10%; sp gr, 8.75; Rock hdns, B 80.

Alloy No. 18A4: Sheet and wire form. Cu 55, Zn 27, Ni 18; in spring temper, ts, 110-145,000 psi; elong in 2 in., 2.3%; sp gr, 8.68; electrical resistivity 18.2; electrical conductivity (IACS), 5.5%.

Alloy No. 18X1: Rod form. Cu 62, Zn 19, Ni 18, Pb 1. Hard drawn temper, ts, 85,000 psi; elong in 2 in., 13%; Rock hdns B 80; electrical resistivity (IACS), 17.6; electrical conductivity (IACS), 5.7%.

Alloy No. 18A7: Sheet, rod and wire. Cu 72, Zn 10, Ni 18; in spring temper, ts, 80-115,000 psi; elong in 2 in., 2-7%; sp gr, 8.83; electrical resistivity (IACS), 16.2; electrical conductivity (IACS), 6.2%.

ELGILOY (Cobalt alloy)—Elgin National Watch Co., Elgin, Ill.

Co 40.00, Cr 20.00, Ni 15.00, Mo 7.00, C 0.15, Mn 2.00, Be 0.04, Fe, balance. Ingots, rough bars or billets, finished rods or bars, straight and coiled strip, and wire. Age-hardening alloy. Properties, heat-treated: Ts, 360,000 psi; ys, 260,000 psi; hardness, 700 Vickers. Properties, unheat-treated: Ts, 170,000 psi; ys, 100,000 psi; hardness, 235 Vickers. Properties, cold-worked: Ts, 270,000 psi; ys, 160,000 psi; hardness, 500 Vickers. Sp gr, 8.3; nonmagnetic; machinability, poor; weldability, good; max cont serv temp, 600 F; abrasion resistance, high. High elastic properties and resistance to set and fatigue. Only corrosion-resistant and nonmagnetic material that has an elastic modulus comparable to steel. For steel tapes, electronic equipment, precision instruments, dental and surgical equipment, watch mainsprings, cameras, flapper valves, vibrating reeds, etc.

ELKALOY A (Welding electrode)—P. R. Mallory & Co., Inc., Indianapolis.

Work-hardened alloy of copper, not heat-treatable, for spot and seam welding aluminum and its alloys, unpickled hot-rolled steel, terne plate, galvanized iron and other materials. Direct substitute for copper, it handles the same but is harder and lasts longer.

ELKONITE (Electrical contact materials)—P. R. Mallory & Co., Inc., Indianapolis.

Three definite classes of materials. One group based on copper and such refractory metals as tungsten, molybdenum and their carbides—combinations which produce material with good electrical conductivity and great wear-resistant qualities, for use as welding electrodes and contactors in oil-immersed circuit breakers. Certain of these grades are heat treatable. Heat treatment improves electrical and physical properties.

Second group based on silver and refractory material such as tungsten, molybdenum, and their carbides, has been developed primarily as facing material for heavy-duty electrical contacts and contactors for air breakers.

Third group comprises basically silver in which is incorporated refractory material such as cadmium oxide or nickel. For heavy contacts, particularly for aircraft, relays, and contact facings and main contacts on heavy-duty breakers.

All three groups can be used in form of thin facings or as inserts with copper or copper alloy backing materials, having high electrical conductivity coupled with high physical properties.

ELKONIUM (Electrical contact materials)—P. R. Mallory & Co., Inc., Indianapolis.

Series of electrical contact materials divided into following groups: Silver, platinum, palladium and gold-base alloys. These groups designed to cover wide range of applications and can be supplied in wide variety of forms.

ELVACET (Polyvinyl acetate plastic)—E. I. du Pont de Nemours & Co., Inc., Polychemicals Dept., Wilmington, Del.

Thermoplastic. Solid beads of low, medium and high viscosity for molding or casting in solution (50% in methanol), and as water emulsion. Soluble in common organic solvents for use as adhesive; compatible with resins, cellulose derivatives and chlorinated rubber. Used as adhesive, binding agent, and as protective coating on machine parts.

ELVANOL (Polyvinyl alcohol plastic)—E. I. du Pont de Nemours & Co., Inc., Polychemicals Dept., Wilmington, Del.

Thermoplastic. Powder form for molding and solvent-resistant rubber substitutes, textile sizings, paper coatings, and adhesives. Highly flexible; dielectric str, low; heat-resistant to 200 F; takes color; shatterproof; sp gr, 1.21-1.31 (powder); translucent; resistant to organic solvents. For oil-resistant gaskets, tubes, rollers, etc., as well as protective coatings on metal parts.

ELVERITE (Special cast iron)—The Babcock & Wilcox Co., New York 6, N. Y.

Sand cast, chill cast, plain and alloyed wear iron. For tube mill liners, roll heads, jaw crushers and special applications.

EMPIRE (Sheet insulation)—Mica Insulator Co., Schenectady, N. Y.

Varnished fabrics, glass cloths and papers in sheet, roll or tape form. Class A, B and H types of electrical insulation for armature, stator, field, transformer, ignition, and regulator coils, high-tension cable splices, phase insulation, ground insulation, etc. Also specialty coating.

ENDURO (Stainless steels)—Alloy Steel Div., Republic Steel Corp., Massillon, O.

Standard stainless steels of AISI type. For data on types, properties, characteristics and applications see "Stainless Steels" listing at end of this section.

Also full range of electric furnace and open-hearth steels of all AISI and SAE grades.

ENRUP (Thermosetting plastics)—U. S. Rubber Co., New York.

Sheets, gear blanks, molded parts. Can be press molded, compression molded, transfer molded, sheet molded, or fabricated from sheets. Properties: Ts, 4,200 psi; Rock hdns, M65; imp str (notched), 1.3 ft-lb; mod elast, 180,000 psi; max cont serv temp (depending upon application), 0-250F; dielectric str, 500 (volts per mil inst); arc resistance, good; fire resistance, fair; sp gr, 1.3. Gears for heavy-duty lathes, household appliances, plating barrels, automotive timing devices, and dynamometers, also washing machine parts.

ENSIGN (Aluminum solder)—Ensign Products Co., Cleveland 5, O.

No. 15: For patching aluminum, magnesium and die-cast metals and for soldering aluminum. Melting point, 600 F.

No. 17: Use is same as No. 15. Melting point, 500 F.

No. 63: Use is same as for No. 15. Melting point, 500 F.

ENSIGN 64 (Die-cast welding alloy)—Ensign Products Co., Cleveland 5, O.

For welding die-cast and white metals; also pot metal. Makes tough weld on die-cast parts. No flux needed.

ERAYDO Alloy (Strip and sheet zinc)—Illinois Zinc Co., Chicago 32.

Zn 99, Cu 0.5-1.0, plus other minor elements. Straight and coiled strip, sheet and plate. Properties, cold-worked: Ts, 28-54,000 psi; machinability, good; weldability, poor; max cont serv temp, 200 F; sp gr, 7.14. Used for nameplates, guards, housings and cases.

ERMALITE (Alloy iron)—Erie Malleable Iron Co., Erie, Pa.

Wear-resisting alloy iron: Wearing plates, friction drums and other parts subject to high stresses or wear.

ERMAL Z-Metal (Pearlitic-malleable iron)—Erie Malleable Iron Co., Erie, Pa.

Spheroidized pearlitic-malleable iron: Castings requiring rigidity, high-tensile strength, and abrasion resistance. Suitable for heat treatment.

ES (Stainless steel sheets)—Eastern Stainless Steel Corp., Baltimore 3, Md.

For type, property and application data, see "Stainless Steels" listing at end of this section.

ESCO (Cast Steels)—Electric Steel Foundry Co., Portland 10, Oreg.

Stainless, manganese, carbon and low alloy steel castings to all commercial analyses.

ETHOCEL (Ethylcellulose plastic) — The Dow Chemical Co., Midland, Mich.

Thermoplastic: Granular form for injection and extrusion molding; also sheeting. High impact strength at low temperature; moisture absorp low; good dimensional stability; sp gr, 1.08 to 1.16; heat resistance, 130 to 160 F; ts, 3,000 to 7,000 psi; translucent, transparent, and opaque colors. Used where toughness and dimensional stability are required.

Eureka (Welding electrodes)—Welding Equipment & Supply Co., Detroit 7.

Tool and die welding electrodes; water hardening, oil hardening, air hardening, hot work tool steel, high speed steel. Also alloy welding electrodes for welding cast iron, bronze castings, copper, heat resisting alloys, and forging dies.

EUTECHROM (Hardsurfacing rod) — Eutectic Welding Alloys Corp., New York 13.

Hard-surfacing alloys for building up new or worn surfaces subject to abrasive wear, and/or to maintain hard and sharp cutting edges. Rods are available either bare or flux-coated for use with the oxyacetylene torch and metallic and carbon arc.

EUTECROD (Welding rod)—Eutectic Welding Alloys Corp., New York 13.

Scientifically developed welding rods used with special fluxes utilizing principal of surface alloying at low heats. These welding rods can be applied with the oxyacetylene torch, oxyhydrogen torch, and induction and furnace heating.

EUTEC-STRAINROD A (Torch rod for stainless)—Eutectic Welding Alloys Corp., New York 13.

Particularly for thin stainless steel sheet where arc welding is too complicated, difficult to apply, or would result in burn-through. Flux coated for faster, smoother weld.

EUTEC-STRAINTRODE (Welding electrode)—Eutectic Welding Alloys Corp., New York 13.

For welding all types of stainless steel, such as 301, 302, 308, 309, 310, 312, 316, 347, and others. Corrosion resistance, excellent; good color match; porosity-free.

EUTECTIC (Welding alloys)—Eutectic Welding Alloys Corp., New York 13.

Welding alloys and special fluxes of a new type that bond to the parent metal below the melting point of the latter, forming exceedingly strong bonds through surface alloying at low heats.

Scientifically developed welding rods which are used with special fluxes and utilize the principle of surface alloying at low heat. These welding rods can be applied with the oxyacetylene torch, metallic and carbon arc, and induction and furnace heating.

EUTECTOFILM (Welding rod coating)—Eutectic Welding Alloys Corp., New York 13.

Scientifically developed coating used on Eutectic low-temperature welding rods to enhance their welding properties and to assist in surface alloying at low heat.

EUTECTRODE (Welding electrode) — Eutectic Welding Alloys Corp., New York 13.

Scientifically developed electrodes which utilize principle of surface alloying. These special flux-coated electrodes are for use with the metallic arc process.

EVANSTEEL (Alloy steel castings) — Chicago Steel Foundry Co., Chicago 32.

Ni 1-1.5, Cr 0.65-1, C varies from 0.3-0.5, sometimes carries additions of V or Mo. For castings such as passenger car knuckles, heavy duty sprockets, gears, high pressure valves, etc. In general, for parts requiring high tensile strength plus good shock and abrasion resistance.

EVERDUR (High copper alloys) — American Brass Co., Waterbury, Conn.

Alloy No. 1010: Cu 95.8, Si 3.1, Mn 1.1. Uses include welded tanks and sewage disposal apparatus.

Alloy No. 1012: Cu 95.6, Si 3.0, Mn 1.0, Pb 0.40. Rods for automatic screw machine production only.

Alloy No. 1000: Cu 94.9, Si 4.0, Mn 1.1. Notched ingots for remelting.

Alloy No. 1014: Cu 91.0, Si 2.0, Al 7.0. Rods for automatic screw machine production and hot forging only.

Alloy No. 1015: Cu 98.25, Si 1.5, Mn 0.25. Easily fabricated by all methods including welding. For tubes, bolts and screws.

EXCELSIOR (Electrical resistance alloy)—Alloy Metal Wire Co., Inc., Prospect Park, Pa.

Ni 45, Cu 55. Round and flat wire and rod. For wire wound resistors, controllers, instruments and other equipment where exacting electrical resistance, good resistance to oxidation and ease of soldering are required.

This company also handles nickel, Grades A, D and E Monel, "R" Monel, "K" Monel, "KR" Monel, "Z" Nickel and Inconel. For property and application data on these, see listings under material name.

E-Z CUT (Alloy steels)—Jos. T. Ryerson & Son, Inc., Chicago 80.

Steel plates. Properties, unheat treated (2 in. plate): Ts, 70,180 psi; ys, 34,080 psi; elong in 2 in., 24.5%; bhn, 140; machinability, good; weldability, good. Can be case hardened with excellent results; machines faster and leaves a smoother machine surface than standard AISI C1020. For die bases, jigs, plastic and rubber molds, gears, pins, guides, broached parts, rings, machine beds, cams, sprockets and bushings.

E-Z EYE (Heat reducing glass)—Libbey-Owens-Ford Glass Co., Toledo, O.

Polished plate glass in sheet form. Abrasion resistance, high; corrosion resistant (except to hydrofluoric acid); heat absorbing; flexibility, medium; mod of rupture, 6000 psi; sp gr, 2.49; transparent; color, bluish-green. Reduces glare. For use where light transmission or vision is desired with insulation against solar radiation.

F-10 to F-80 (Powder metal)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

Pressed and sintered parts of bronze, nickel and stainless steel powder metals. For filtering oil and water, mixing of gases, controlling flow, etc., in air conditioning units, refrigerating units, gas burners, etc.

FABREEKA (Vibration and noise damping materials)—Fabreeka Products Co. Inc., Boston 10, Mass.

Layers of tightly twisted, closely woven lightweight cotton duck, each layer thoroughly impregnated with special rubber compound. Layers built up to required thickness and vulcanized together. Static load breakdown limit, 12,000-20,000 psi. Primarily recommended for use under heavy loads and for isolating high-frequency vibration without sacrifice of stability. Damping ratio, 1.6. Many thicknesses available.

FABROIL (Silent gears of cotton material)—General Electric Co., Chemical Dept., Coshocton, O.

Oil-treated gear blanks for machining. High impact resistance.

FACEWELD (Welding electrode)—Lincoln Electric Co., Cleveland 1, O.

Arc welding electrode that produces chromium carbide weld-metal deposit. Ideal for hard surfacing where severe abrasion and moderate impact are encountered on such parts as screw conveyors, wire feed rolls, pulverizer jaws, etc.

FAHRALLOY (High alloy steel)—The Fahralloy Co., Harvey, Ill.

Various grades. Ni 65, Cr 5-30, Mo 0-3, C 0.07-1.00, balance Fe. Sand castings, no heat treatment required. Ts, 80,000 psi; ys, 40,000 psi; elong in 2 in., 30%; bhn, 160-400; sp gr, approx 7.00; weldability, good; max cont serv temp, 2000 F. For heat-treating furnaces, food machinery, ore roasters, etc.

Ni 65: Cr. 14-30, C 0.07-2. Sand castings to specification. Properties, unheat-treated: Ts, 75,000 psi; ys, 40,000 psi; elong in 2 in., 1-40%; bhn, 200-400; sp gr 7.9. Machinability, fair; weldability, good. Resists corrosion caused by most acids, gases and high temperatures; max cont serv temp, 2000 F.

Also Types 2, 2a, 2b, 3, 4 and 5 Ni-Resist nickel iron sand castings (see Ni-RESIST listing for properties).

FAHRITE (Alloy steel castings)—The Ohio Steel Foundry Co., Springfield, O.

Group of heat resistant and corrosion resistant alloy steels primarily of the chromium-molybdenum type. Castings to specification.

FAIRPRENE (Synthetic rubber-coated fabrics)—E. I. du Pont de Nemours & Co. Inc., Fabrics Div., Fairfield, Conn.

Woven fabrics of cotton, nylon, rayon, glass, asbestos or felt, fibers, etc., coated with oil-resistant synthetic rubber. Used for parts such as diaphragms, gaskets, washers, packings, shock and insulating pads, seam sealing, and similar applications in the chemical, oil and other industries.

FALLS (Wrought iron)—Falls Hollow Staybolt Co., Cuyahoga Falls, O.

C 0.016, P 0.099, Si 0.114, Mn, 0.33, S 0.018. Rough bars or billets for machining. Properties, untreated: Ts, 48-52,000 psi; elong in 8 in., 30%; weldability, very good; machinability, good. For staybolts in locomotive type boilers.

FANSTEEL (Corrosion-resistant, high-strength metals)—Fansteel Metallurgical Corp., North Chicago, Ill.

Molybdenum: Mo 99.9+. Finished rods bars, wire, sheets, strips and powder met for stamping, turning, boring, welding i parts. Ts, 260,000 psi; impact resistan high; bhn, 14[illegible]; sp gr, 10.2; nonmagnet resists corrosion caused by most acids; m cont serv temp, 3000 F in protective atm phere; abrasion resistance, medium. Us for critical electrical parts.

Tantalum: Ta 99.9+. Finished rods or ba tubing, wire, sheets and strips; for stam ing, turning, boring, welding, etc. Ts, 178,000 psi; impact resistance, mediu bhn, 75-125; sp gr, 16.6; nonmagnet weldability, good. For corrosion-resisti parts.

Tungsten: W 99.95. Furnished in rough ba or billets, finished rods or bars, wire, shee shapes, powder metal and ribbon; for for ing, fabricating and powder metallurg Properties, untreated: Ts, 490,000 psi; i pact resistance, high; bhn, 290; sp gr, 19. magnetic; resists corrosion caused by mo acids; abrasion resistance high.

Fansteel 77 Metal: Tungsten-copper-nickel a loy. Bars, rods, rings, disks, slabs special shapes. Ts, 90,000 psi; Rock hdn 20-25C; sp gr, 16.7 grams/cc or 0.603 lb cu.in. Readily machinable, easily brazed silver soldered. Characterized by hig density; used for parts for rotational co trol—rotors, flywheels, governors, balanc weights. Also used for radiation shields f x-rays, etc.

FARLITE (Thermosetting plastics sheets)—Farley & Loetscher Mfg. Co., Dubuque, Iowa.

Phenolic and melamine base. For machinin and stamping into parts; corrosion-resistant highly polished; moisture absorp, low; im pact-resistant; in colors; ts, 10-12,000 psi dielectric str, to 700 (volts per mil inst) For circuit barriers, panel boards, washer terminal strips, and for parts requiring mod erate chemical resistance.

Gear stock: Fabric base. Blanks of desire thickness; moisture resistance, high; ts, 11,000 psi; comp str, 39,500 psi; flex st to 20,000 psi; and dielectric str, to (70 volts per mil inst).

FARLITE COMPREG (Plastic-impregnated wood veneer)—Farley & Loetscher Mfg. Co., Dubuque, Iowa.

Wood veneer impregnated with thermosetting synthetic resins before compressing. Thicknesses to 2 in.; for machining with same tools as for cast iron. Impact resistance good; corrosion resistance, good; moisture absorp, low; ts, 30,000 psi, comp str, 23,000 psi; dimensional stability, good; modulus of rupture in bending, 35,000 psi. For bearing plates, bolts, studs, propeller blades instrument panels, mechanical spacers, etc.

FARMFACE (Welding rods and electrodes)—American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

C 4.0, Mn 6.0, Si 2.0, Cr 30.0. Bhn, 500-600. Abrasion resistant up to 600 F. For hardfacing only; austenitic iron deposits slightly magnetic; abrasion resistance, good in fine-grained soils. Excellent for hardfacing plowshares, disks, and other agricultural parts subject to soil abrasion.

FARRELL'S (Alloy steel castings) — Farrell-Cheek Steel Co., Sandusky, O.

Farrell's 1025 steel.

Farrell's 1040 steel. Furnished annealed; also heat treated, with following range of properties: Ts, 85-95,000 psi; ys, 50-65,000 psi; elong in 2 in., 18-19%; bhn, 170-200.

Farrell's 85—Grade T: Carbon steel. Properties, heat-treated: Ts, 82,000 psi; ys, 44,000 psi; elong in 2 in., 21%; bhn, 180.

Farrell's 85 — Manganese-molybdenum base: Ts, 90-175,000 psi; ys, 60-150,000 psi; elong in 2 in., 20-6%.

Farrell's 85 — Copper-manganese-molybdenum alloy: Ts, 90-175,000 psi; ys, 60-150,000 psi; elong in 2 in., 20-6%; bhn, 193-363. Exceptionally free cutting; savings up to 25% of machining time possible at higher bhn.

Farrell's 85 — Vanadium-manganese-molybdenum alloy: Fine grain; shock resistant; high impact at low temperatures. Ts, 90-175,000 psi; ys, 60-150,000 psi; elong in 2 in., 20-6%; bhn, 193-363.

Farrell's Hard Edge: Physical properties at core: Ts, 110,000 psi; ys, 90,000 psi; elong in 2 in., 20%; bhn, 500-700.

FEATHERWEIGHT (Magnesia composition) — Keasbey & Mattison Co., Ambler, Pa.

Magnesia blocks, pipe covering and cement. Combination of magnesia and asbestos fiber with exceptionally low thermal conductivity and light density. Used as a thermal insulating material for temperatures up to 600 F.

FEDERAL (Bronzes) — Federal Mogul Corp.

Detroit.

F1: Gear bronze suitable for heavily loaded piston pin bushings, etc.

F2: Lead bronze for average bushings application.

F3: Backs for babbitt-lined bearings.

F5: Babbitt-lined bearing backs and for bushings where service is not severe.

F6: Can be used for average bushing applications, but requires good lubrication.

F8: Good casting and machining qualities.

F11: For piston pin bushings and other low speed, heavily loaded applications.

F15: Pb 20. Used safely under adverse lubrication conditions.

F16: Because of high lead content may be used where only occasional lubrication is possible.

F18: High lead alloy of good casting characteristics.

F20: Hard bronze used for gears and worm wheels where requirements are severe; also aluminum - bronze and special analysis bronzes.

F28: For use as compressor seals in refrigerators, ventilating equipment and similar applications.

FELPRO (Fiber-rubber-cork-felt material)—Felt Products Mfg. Co., Chicago 7.

Sheets and strips and in fabricated parts. Can be stamped or extruded into parts. For gaskets, metallic, semi-metallic, and fibrous valve and pump packings for all applications.

FELTAN (Rubberized felt)—American Felt Co., Glenville, Conn.

Microporous sheet material, strip or cut parts for stamping. Abrasion resistance, medium; chemical resistance, as required; max cont serv temp, 300 F; nonflammable; flexibility, high; ts, 100 psi; trans str, 10 psi; flex str, high; elongation, 1500%; moisture absorption, high; red, brown, black, grey, tan and white; opaque; shatterproof; sp gr, 1.2. Nonskid surfacing material for instruments, machines and vibration mountings, filters, etc.

FELTERS (Felts)—The Felters Co., Boston.

Nonwoven felts manufactured to highest standards and in accord with SAE and other specifications. Piece, roll, strip, or in parts precision-cut to specific requirements. Uses include pads, bumpers, anti-squeak and anti-rattle parts, filters, polishing roll covering, shaft and bearing seals and other applications. Petroleum-resistant.

FERRAMIC "G" (Magnetic ferrites)—General Ceramics & Steatite Corp., Keasbey, N. J.

Compounds of various metal oxides having the general formula $MoFe_2O_3$ where M stands for the bivalent metal ion such as nickel, zinc, etc. Max. permeability as high as 3500 and resistivity 1.5 x 10^8 ohm-cm. Curie pt. 160° C. Powder from pressed or extruded to desired form. For h-f magnetic circuit components.

FERROWELD (Welding electrode) — Lincoln Electric Co., Cleveland.

For arc welding cast iron. Has steel base to give solid weld on cast iron of greater tensile strength than the cast iron. Due to low current which can be used, hardening effect usually present along the line of fusion is materially reduced.

FIBERGLAS (Glass fiber materials) — Owens-Corning Fiberglas Corp., Toledo, O.

Wool-type fibers for thermal and acoustical insulation, compressed to various densities, in form of batts, blanks, boards, tile, blocks, etc. Thin porous bonded mats for underground pipe wrap, storage batteries, for filter or aeration packs. Two types of textile fibers—continuous filament and staple fiber—for service fabrics, chemical filtration, electrical insulation, reinforcement in laminates, plastics, etc. Basic properties of wool products are light weight, low thermal conductivity. Wool products have good sound absorption, are resistant to moisture, individual fibers are incombustible, durable, sanitary, wide temperature range (from subzero to 1000 F).

Thermal insulations include medium and high-temperature blocks, low-temperature (asphalt-enclosed) blocks, pipe insulations, metal mesh blankets, etc., for all industrial equipment applications and roll blankets for building insulation.

Electrical insulations for magnet wire, motors, generators, transformers—varnished cloths used for high temperature cambric applications; inorganic backing and reinforcement in mica combinations; for producing electrical laminates; for high temperature electrical adhesive tape. Tapes used for binding coils and other parts to be impregnated after wrapping; various electrical applications. Electrical tying cord for binding coils in generators and armatures, in transformers and similar static applications. Braided sleevings are used for lead wires in motors and transformers and similar applications.

Industrial textiles for high temperature pipe lagging, welding curtains.

Dust-Stop: Air-filters; used wherever air is moved mechanically in ventilating, heating and air-conditioning systems and in forced warm air furnaces and packaged air-conditioners.

Coromat: High-strength underground pipe wrap. Fiberglas pipeline outer wrap for additional protection of pipe where soil conditions and different specifications warrant.

Aerocor: Light-weight blanket-like material for thermal and acoustical insulation.

FIBER PLAST (Phenol formaldehyde plastic)—International Textile Co., Chicago, Ill.

Thermosetting plastic powder for compression molding. Abrasion resistance, high; max cont serv temp, 200 F; flex str, 9000-12,000 psi; ts, 6000 psi; compr str, 22,000 psi; imp str (Izod), 5-7 ft-lb; red, green, black, brown; moisture absorp, low; sp gr, 1.38; machinability, good; excellent wearing quality. For bearings, gears, caster wheels, etc.

FIBESTOS (Cellulose acetate plastics)—Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Thermoplastic sheet, laminates and powders, for molding, machining, stamping or swaging into parts. Resistant to corrosion; transparent; in colors; flexible; tough; high polish; dielectric str, 290-600 volts per mil; ts, 5500-10,000 psi. For safety glass, and compressible shims, couplings, gaskets, electrically insulated knobs and handles, light diffusing panels, and molded shapes.

FIBRON (Plastic tape and tubing)—Irvington Varnish & Insulator Co., Irvington, N. J.

Plastic tape: Polyvinyl chloride, thermoplastic. Heat-sealing, flame-resistant tape for insulating and protecting against abuse and corrosion of wires, cables and electrical equipment; suitable also for splicing electrical cables and for covering piping and equipment exposed to acids, alkalies, moisture, oil and grease. Dielectric str, 1000 (volts per mil inst), (0.012-in. thickness); ts, 1600 psi.

Plastic tubing, No. 5373: Polyvinyl chloride, thermoplastic. Rods and tubes for extruding. Abrasion resistance, high; chemical resistance, good; max cont serv temp, 180 F; dielectric str, 1000 (volts per mil inst); ts, 3000 psi; in black, green, red, white, yellow and blue; moisture absorp, low; machinability, good. For wire insulation, conduit lug insulation, etc.

FINKL (Alloy steel)—A. Finkl & Sons Co., Chicago.

CNM: Cr-Ni-Mo; C 0.40. Heat-treated to various tempers. For large-section forgings or forgings of irregular section not suitable for heat-treating by liquid quenching.

FS: C 0.50, Cr, Ni and Mo. Annealed; oil quench; for die blocks. Miscellaneous forgings subject to forging temperatures and/or abrasion.

FX: C 0.55, Cr, Ni, and Mo. Heat-treated to various tempers, all commercially machinable. For use as drop hammer dies and blocks, forging machine dies, backing-up rolls and dipper teeth.

FIRECRETE (Castable refractory) — Johns-Manville, New York 16.

Four grades; Standard Firecrete for temperatures up to 2400 F; High Temperature Firecrete up to 2800 F; Light Weight Firecrete up to 2400 F; and 3X Firecrete up to 3000 F. For furnace covers and bottoms, door linings, special shapes and many other types of monolithic refractory construction.

FIRTHALOY (Tungsten-carbide)—Firth-Sterling Steel and Carbide Corp., McKeesport, Pa.

Highly developed form of sintered carbide adapted to wire drawing dies, extrusion dies and similar purposes.

FIRTHITE (Tungsten-carbide) — Firth-Sterling Steel and Carbide Corp., McKeesport, Pa.

Hard metal composition of sintered carbides furnished in a number of grades to form wearing surfaces or the edges of cutting tools.

FLEETWELD (Welding electrodes) — Lincoln Electric Co., Cleveland.

Shielded-arc electrodes for welding mild steel:

Type 5: For flat, vertical and overhead welding. Ts, 65-75,000 psi; impact resistance, 30-70 ft-lb (Izod). AWS Class E-6010.

Type 7: For general-purpose welding and where fit-up is not of best. Low spatter and slag loss; high burn-off rate. Properties, as welded: Ts, 70-80,000 psi; yp, 55-66,000; elong in 2 in. approx 17%; sp gr, 7.80. AWS Class E-6012.

Type 11-HT: Heavily coated electrode of shielded-arc type for deep-groove welding in flat position of high tensile steels. AWS Class E-7020.

Type 11: Heavily coated electrode of shielded-arc type for downhand fillet welding with "Fleet-Fillet" technique. AWS Class E-6020.

Type 35: For flat, vertical and overhead welding on both ac and dc. Properties similar to Type 5 electrode. AWS Class E-6011.

Type 37; For flat, vertical and overhead welding on mild steels. Especially designed for welding sheet metal. Properties similar to Fleetweld 7. AWS Class E-6013.

Type 47: For flat, vertical and overhead welding on mild steel where ease of operation and cleaning are essential. Properties similar to Fleetweld 7, AWS Class E-6013.

FLEXSEAL (Laminated shatterproof plate glass)—Pittsburgh Plate Glass Co., Pittsburgh 19.

Laminated plate glass with extended Vinyl plastic edge, flat and bent sheets. Corrosion and abrasion resistance, high; heat-resistant, 180 F; flexibility, medium; moisture absorp, low; shatterproof; transparent; highly polished; flexible edge simplifies installation. For windows having nonrigid frames or requiring airtight edge seal.

FLUXINE (Coated welding rods)—Krembs & Co., Chicago 10, Ill.

Welding rods for joining copper by metallic arc welding.

FLYLITE (Magnesium-base alloy)—Magnesium Div., Howard Foundry Co., Chicago.

Grade No. 8: Al 5.3-6.7, Mn 0.15 min, Zn 2.5-3.5, Si 0.3 max, Cu 0.05 max, Ni 0.005, others 0.3, Mg remainder. As cast: For castings requiring moderate strength and toughness. Heat-treated: For castings requiring high strength and maximum toughness. Heat-treated and aged: For castings requiring high yield strength, hardness, moderate toughness.

Grade No. 4: Al 8.3-9.7, Mn 0.1 min, Zn 1.7-2.3, Si 0.3 max, Cu 0.05 max, Ni 0.005, others 0.3, Mg remainder. Characteristics similar to Flylite No. 8. Flylite No. 4 is preferred for maximum pressure tightness.

FOLLANSBEE (Cold rolled strip steel)—Follansbee Steel Corp., Pittsburgh 22, Pa.

Carbon steel of AISI analysis in straight and coiled strip.

FORMETAL (Bushings and bearings)—National Formetal Co. Inc., Cleveland 14.

Bearings, bushings, sleeves, ferrules, tubes in short lengths of any metal or alloy, to specifications.

FORMICA (Laminated thermosetting plastics)—The Formica Co., Cincinnati 32.

Resinous base, thermosetting. Laminated form, for machining or stamping into parts. Corrosion-resistant; ts is slightly less than cast iron; dielectric strength, high; absorbs no oil; changes in dimensions only slightly as the result of moisture absorp. Used for insulating washers and bushings, punched parts in switches, automotive starting systems and all types of heavy-duty gears.

Grade C: Phenolic laminated fabric. Sheets and in rods or tubes; high polish; corrosion-resistant to acids and salts, not alkalies; flexible in thin sections; dielectric str, 200 (volts per mil inst) in 1/16-in. thick; ts, 10,000 psi; max cont serv temp, 300 F. For silent gears.

Grade CNP-22: Laminated phenol-formaldehyde. Sheets, rods or tubes for machining into parts. Abrasion resistance, high; resistant to all electroplating solutions except chromic acid; max cont serv temp, 275 F; flexibility, low; dielectric str, 200 (volts per mil inst); ts, 7500 psi; flex str, 12,500 psi; moisture absorp, low; shatterproof; sp gr, 1.36; opaque; in natural tan; machinability, fair. For chemical resistant parts such as gears and panels for electroplating equipment.

Grade CJP-11 and CBP-11: Laminated phenol-formaldehyde. Sheets up to 36 x 96 in.; abrasion resistance, medium; max cont serv temp, 275 F; flex str, 17,000 psi (ASTM D 650-42T); ts, 9000 psi; comp str, 36,000 psi (flat); in olive green (CJP-11), and black (CBP-11); moisture absorp, medium; sp gr, 1.36; opaque; machinability, good. A post-forming grade for bending or drawing into various shapes after pressing.

Formed shapes have good rigidity and dimensional stability.

Grade FF-55: Melamine formaldehyde. Laminated sheets up to 36 x 96 in., and in rods and tubes. Abrasion resistance, medium; chemical resistance, not recommended except for use with water or very mild alkali solutions; max cont serv temp, 390 F; flex str, 35,000 psi (facewise) and 40,000 psi (edgewise) (ASTM D 650-42T); dielectric str, 500 (volts per mil inst); ts, 25,000 psi; comp str, 55,000 psi (flat); impact str (Izod), 12 ft lb/in. notch; in light brown; opaque; moisture absorp, medium. For parts requiring good arc and fire resistance together with good mechanical strength, such as electrical instrument panel boards.

Grade LN-41: Laminated melamine formaldehyde. Sheets, rods or tubes for machining. Abrasion resistance, medium; very resistant to alkaline solutions but poor resistance to acids; max cont serv temp, 280 F; flexibility, low; ts, 20,000 psi; dielectric str, 370 (volts per mil inst); comp str, 44,000 psi; flex str, 26,000 psi; moisture absorp, low; in ivory; opaque; sp gr, 1.5; shatterproof. For electroplating barrel parts for alkaline solutions and other electrical fabricated parts requiring electrical arc resistance.

Grade RN-30: Random cotton-phenolic laminate in sheet, strip, small diameter rods and plate. Abrasion resistance, medium; max cont serv temp, 250 F; slow burning; flexibility, medium; dielectric str, 250 (volts per mil inst), (for ⅛-in. thickness); ts, 15,500 psi; comp str, 41,000 psi; flex str, 20,000 psi; moisture absorp, medium; only in natural color; sp gr, 1.35; opaque; machinability, fair. For gears and fabricated insulating parts requiring uniform strength.

Grade RGN-30: Same general characteristics and properties as RN-30 except that it has been dimensionally stabilized for use in gears.

Grade XX: Phenolic laminated paper. Laminated form, rods or tubes; high polish; dielectric str, 500 (volts per mil inst); ts 12,000 psi; max cont serv temp, 300 F; in natural and black; moisture absorp, low. Used for insulation for electrical equipment.

Grade XXXP: Phenol formaldehyde. Sheets; abrasion resistance, high; max cont serv temp. 225 F; flex str, (ASTM D 650-42-T), 17,500 psi; dielectric str, 710 (volts per mil inst); ts, 13,500 psi; in natural and black colors; moisture absorp, low; sp gr, 1.35; opaque; machinability, fair. For punched parts in radio transmitter and receiving equipment.

Grade XXP: Laminated phenolic, paper base. Sheet form. Abrasion resistance, high; chemical resistance, poor; max cont serv temp, 225 F; slow burning; flexibility, medium; dielectric str, 650 (volts per mil inst), (1/16 in. thickness); ts, 8000 psi; comp str, 25,000 psi; flex str, 17,500 psi; moisture absorp, low; in natural and black colors; sp gr, 1.36; opaque; machinability, good. For punched parts which are to be used in applications where moisture resistance is a prime requirement.

Grade XP: Laminated paper base phenolic. Sheet form. Abrasion resistance, high; chemical resistance, poor; max cont serv temp, 20 F; slow burning; flexibility, high; dielectric str, 700 (volts per mil inst), (1/16 in. thickness); ts, 8000 psi; comp str. 22,000 psi; flex str, 17,000 psi; moisture absorp, medium; in natural, chocolate brown, and black colors; sp gr, 1.36; opaque; machinability, fair. For punched parts to be used in electrical insulation for automotive ignition or 110-volt apparatus.

Grade YN-25: A nylon-phenolic laminate. Sheets, strips, rods, tubes and plates. Abrasion resistance, medium; max cont serv temp, 300 F; is nonflammable; flexibility, high; dielectric str, 350 (volts per mil inst); ts, 6000 psi; comp str, 30,000 psi; flex str, 10,000 psi; moisture absorp, very low; only in natural color; shatterproof; sp gr, 1.17; opaque; machinability, good; Rock hdns, M100. For radio and electronic insulation, etc.

FORTICEL (Cellulose propionate plastics)—Celanese Corp of America, Plastics Div., New York 16.

Granules for injection and extrusion molding. Abrasion resistance medium; wide solubility in organic solvents; max cont serv temp depends upon use and formula; flex str, 4800-10,000 psi (ASTM D 650-42T); dielectric str, 370-425 (volts per mil inst), (⅛-in. thickness); ts, 2800-6000 psi; impact str, 0.8-11.4 ft lb (Izod); in colors; transparent, translucent and opaque; moisture absorp, low; sp gr, 1.17-1.22; machinability, good. For vacuum cleaner parts, housings, radio cabinets, etc.

FORT PITT (Stainless steel castings)—Fort Pitt Steel Castings Div., Pittsburgh Steel Foundry Corp., McKeesport, Pa.

Stainless steel castings of standard AISI types produced to specification.

FRANKITE (Alloy irons) — Frank Foundries Corp., Moline, Ill.

E-212: Low-carbon electric furnace iron. Pressure-resistant and long-wearing dense grain in heavy sections. For hydraulic bodies, refrigerator parts, compressor cylinders, etc.; machinability, good.

E-450: Ni 14, Cr 2, Cu 6, electric furnace Ni-Resist. Corrosion-resistant; max cont serv temp, 1500 F; machinability, fair.

E-604: Ni 4½, Cr 1½, electric furnace Ni-Hard white iron. Combats corrosion. For mixer blades, ash chutes, scrapers, etc.

E-830-N: Cr 30, Ni 3, low carbon. Heat-resistant. For continuous oven kilns, cement kiln cooler parts, furnace supports, etc.

FRANKLIN (Hard vulcanized fiber)—Franklin Fibre-Lamitex Corp., Wilmington, Del.

Thermosetting, zinc-chloride treated paper. Sheet, rods, tubes and screw machine parts. Abrasion resistance, high; chemical resistance, good; dielectric str (volts per mil inst), 200-300; ts, 5000-6500 psi; in red, gray, black and white; moisture absorp, medium; weight 0.8 lb per cu in.; opaque; machinability, good.

FROGALLOY (Arc welding rods)—McKay Co., The, Pittsburgh 22, Pa.

C: Modification of 18-8 Cr-Ni austenitic steel arc welding electrodes for surfacing of carbon and mild alloy steels. Deposit properties: Ts, 115,000 psi; ys, 90,000 psi; as-welded hardness, bhn 250-280; as hardened by impact, bhn 480-615; slightly less corrosion resistance than 18-8. Work-hardens rapidly to high surface hardness; extremely tough and impact resistant. For surfacing of pulverizing hammers, crusher jaws, railway frogs and switches, wear plates, etc.

M: Modification of 18-8 Cr-Ni austenitic steel arc welding electrodes for surfacing of manganese austenitic steels. Properties of deposit: Ts, 115,000 psi; ys, 90,000 psi; as-welded hardness, bhn 250-280; as hardened by impact, bhn 480-615; slightly less corrosion resistance than 18-8. Work-hardens rapidly to high surface hardness; extremely tough and impact resistant. For surfacing of pulverizing hammers, crusher jaws, railway frogs and switches, wear plates.

FRONTIER (Bronzes)—Frontier Bronze Corp., Niagara Falls, N. Y.

40 E: Sand casting and ingot form; Properties, untreated: Ts, 32,000 psi min; ys, 22,000 psi min; elong, 3-10%. Resists salt water corrosion; abrasion resistance, high; machinability, excellent; resistant to hydrostatic pressure; resistance to shock and impact, high. For high strength parts.

No. 5: Aluminum bronze. Castings. Ts, 60-95,000 psi; comp str, 22-65,000; ductility, good; bhn (untreated), 120; (heat-treated) 130-200. For parts where resistance to shock, fatigue and wear are essential.

No. 11: Nickel bronze. Bearing qualities with positive lubrication, good; wear-resistant. Properties, heat-treated: Ts, 60-70,000 psi; ys, 38-45,000; elong, 15-20%; bhn, 160.

FURATONE (Resins)—Irvington Varnish & Insulator Co., Irvington, N. J.

Synthetic resins based on furane, which are used as compounding, laminating, and bonding resins and in protective coatings of high acid and alkali resistance. Also used as the bond in molding powders. Supplied in liquid to solid states as required.

FUSION (Micro-film paste type alloys)—Fusion Engineering Co., Cleveland, O.

Brazing compound in paste form with flux, cleaning and tinning agent included. For joining all types of metals.

FV (Radio spaghetti)—Irvington Varnish & Insulator Co., Irvington, N. J.

Flexible lacquered tubing for electrical insulation. Meets ASTM and NEMA standards for grade A-A-2 flexible varnished tubing; resistant to aging, oil, moisture, acid vapors, weak alkalies. Obtainable in five colors.

FYBEROID (Fish paper) — Wilmington Fibre Specialty Co., Wilmington 99, Del.

Sheet form for machining or stamping into parts. Dielectric str, 200-400 (volts per mil inst); ts, 5000-8000 psi; flexible; abrasion and corrosion-resistant. Used for insulation on motors, generators, automotive ignition starters, etc.

FYBR-TECH (Plywood)—Technical Ply-Woods, Chicago 1.

Thermosetting: Sheet form for simple molding. Abrasion resistance, excellent; resists corrosion, repels termites; heat resistance, good; bonded at 350 F; flexibility, good dielectric str, high; ts and comp str, goo to excellent depending on construction moisture absorp, fair to excellent whe treated; in stock colors, gray, red, green o white; pigmented to match in large quan tities; machinability, excellent.

G ALLOY (Lead-base bearing alloy)—America Smelting & Refining Co., New York.

Ingots for spinning and mold casting. Ma cont serv temp, 300 F; abrasion resistance high; ts, 10,000 psi; comp str, 15,000 psi bearing properties, good; bhn (untreated) 22. Used for bearing applications. Is bein widely substituted for tin babbitts.

GALVANNEALED (Steel sheet) — Continenta Steel Corp., Kokomo, Ind.

Sheets. Uniform zinc coating, tightly bonded Ideal for painting. Sizes: Gage, 14 to 28 width, 48 in. max; length, 144 in. max de pending on gage.

GARIT (Cold-molded plastics) — Garfield Mfg Co., Garfield, N. J.

Thermosetting: Corrosion resistant; dielectric str, 50-60 (volts per mil inst); ts, 1200 psi; max cont serv temp, 500 F; moisture absorp, 2%; nonflammable; comp str, 7500 psi. Used for molded insulation for electrical equipment.

GASKOFELT (Felt-rubber material) — Western Felt Works, Chicago.

Compact combination of felt with an oil-resistant rubber compound of great density and high tensile strength. Used for gasketing in connection with oil, steam, hot or cold water; max cont serv temp, 250 F; pressures up to 225 lb.

G-E (Phenolic molding materials)—General Electric Co., Chemical Dept., Pittsfield, Mass.

Phenol formaldehyde powders for compression and transfer molding. Resistant to water, oils, solvents and most acids; attacked by strong acids and alkalies; max cont serv temp, 212-300 F; flex str, 8000-11,000 psi (ASTM D 650); dielectric str (volts per mil inst), 200-400; ts, 6000-8000 psi; compr str, 20-30,000 psi; imp str (Izod), 0.3-3.5 ft-lb per inch of notch; black, brown, red, green and mottled; moisture absorp, 0.1-1.5; sp gr, 1.36-1.90; opaque; machinability, fair to good; Rock hdns, M 75-115; coef thermal exp'n 3 x 10-5. Good electrical insulation characteristics, high gloss finish, good moldability. For wiring device parts, radio industrial control and television cabinets, spools, switch bases, distributor caps, housings, instrument cases, cams, bearings, elevator guides, pulleys, knobs, handles etc.

G-E (Silicone rubber) — General Electric Co., Chemical Dept., Pittsfield, Mass.

Exceptionally high heat resistance; do not adhere to or corrode metal contacting surfaces. At low temperatures do not increase in hardness or become stiff.

Type 12,600: sp gr, 2.0; hardness, durometer Shore A, 40; compression set, at 150 C, 30%; ts, 275 psi; elong, 200%.

Type 12,601: sp gr, 2.0; hardness, durometer Shore A, 60; compression set, at 150 C, 45%; ts, 450 psi; elong, 150%.

Type 12,602: sp gr, 1.40; hardness, durometer Shore A, 70; compression set at 150 C, 35%; ts, 650 psi; elong, 110%.

Type 12,603: sp gr, 1.50; hardness, durometer Shore A, 80; compression set at 150 C, 30%; ts, 600 psi; elong, 75%.

GEMFLEX (Thermoplastic plastics) — Gemloid Corp., Elmhurst, L. I., N. Y.

Vinyl chloride acetate: Rods and tubes, and for molding and extruding into parts. Resistance to acids, alkalies, oils and water excellent; max cont serv temp, 150-160 F; dielectric str, approx 1100 (volts per mil inst); ts, 2500 psi; moisture absorp, low; transparent, translucent and opaque; strong and tough at lower than freezing temperatures; fatigue str, high; flexibility unusual. For insulating, gasketing, etc.

GEMLITE (Acrylic thermoplastic plastics) — Gemloid Corp., Elmhurst, L. I., N. Y.

Laminated sheets, rods and tubes of injection molding; corrosion and impact-resistant; ts and dielectric str, high; max cont serv temp, 150-160 F; nonflammable; takes high polish; transparent, opaque and translucent; in colors; moisture absorp, low; machinability, good. Used for handles, knobs, nameplates, dials, etc.

GEMLOID (Sheet plastics) — Gemloid Corp., Elmhurst, L. I., N. Y.

Thermoplastic and thermosetting materials: Sheet and laminated form for stamping into parts. Abrasion resistance, medium; max cont serv temp thermoplastics, 175 F, for thermosetting type, 400 F; ts, 4000-6000 psi;

moisture absorp, low; nonflammable. For replacing metal nameplates.

GEMPCO (Metallic friction materials)—General Metals Powder Co., Akron, O.

Friction materials of powdered copper and other powdered metallic and nonmetallic ingredients, blended, compressed to shape and heat-treated. Riveter or brazed to metal backing. Thicknesses from 0.012-in. up. For clutch disks, clutch and brake linings.

GENERAL (Aluminum oxide)—General Ceramics & Steatite Corp., Keasbey, N. J.

Rods, tubes and plates. Abrasion resistance, high; nonflammable; trans str, 29,000 psi; moisture absorp, low; in white, opaque. For use where high strength for insulation is required.

GENERAL (Rubber)—The General Tire & Rubber Co., Mechanical Goods Div., Wabash, Ind.

All types of rubber, molded and extruded for household, industrial and automotive applications. For gaskets, grommets, bushings, rings, pump diaphragms, washers, casters, extruded seals, channel strips, glass-run channels, fan belts, etc.

GENERAL PLATE (Manganese alloys) —General Plate Div., Metals & Controls Corp., Attleboro, Mass.

No. 715: Mn 15.0, Ni 15.0, balance Cu. Solid or metal clad. Properties (age hardened): Vickers hdns, 200-320; ts, 100-133,000 psi; ys (0.01% offset), 40-44,000 psi; elong, 20-12. Nonmagnetic; corrosion resistance compares to 18% nickel silver; color silvery white; max cont serv temp 400 F, or 900 F for short durations. For springs, diaphragms, clips, and small parts of intricate shape.

No. 720: Mn 20.0, Ni 20.0, balance Cu. Solid or metal clad. Properties (age hardened): Vickers hdns, 200-425; ts, 102-175,590 psi.; ys (0.01% offset), 48,840-149,270 psi; elong, 15-0.5. Nonmagnetic; corrosion resistance compares to 18% nickel silver; color silvery white; max cont serv temp 400 F or 900 F for short durations. For springs, diaphragms, bellows, etc.

GENEX (Welding electrodes)—Metal & Thermit Corp., New York 5.

General-purpose, ac or dc, straight or reversed polarity. For welding mild steels. Joint properties: Ts, 68-80,000 psi; elong in 2 in., 17-25%. AWS E6012.

Genex M: General-purpose, ac or dc, straight or reversed polarity. For welding mild steels. Joint properties: Ts, 68-80,000 psi; elong in 2 in., 17-25%. AWS E6012.

GEON (Polyblend)—B. F. Goodrich Chemical Company, Cleveland 15, Ohio.

Geon polyvinyl chloride plasticized with Hycar American Rubber during manufacture. Nonmigrating and non volatile, Geon polyblend combines the oil, chemical, and age resistance of polyvinyl chloride with the flexibility and solvent resistance of nitrile rubber. The same processing methods are used as for Geon resins with slight temperature adjustment. Compounds may be calendered, extruded, injection or compression molded and solution coated. Widely used as calendered packaging film for vegetable and animal fats, oils, and greases (oleomargarine); extruded non-migrating wire insulation; and calendered film and sheeting for women's handbags, upholstery, etc. Supplied as thin sheets or fine powders.

GEON (Polyvinyl chloride thermoplastic)—B. F. Goodrich Chemical Co., Cleveland 15.

Granules, powders and latices. For injection and compression molding, extruding, calendering and coating. Excellent chemical resistance except for ketones and chlorinated hydrocarbons. Max cont serv temp, 150 F; dielectric str, 400-2000 volts per mil; ts, to 3500 psi; produced in all NEMA colors; transparent, translucent and opaque, moisture absorp, low; sp gr, 1.3. For electrical insulation, beverage tubing, gasket and packing material, automotive body or refrigerator strips unsupported film and sheeting, coated fabrics, etc.

GIBSILOY (Powder metal)—Gibson Electric Co., Pittsburgh 21, Pa.

Electrical contact materials made by powder metallurgy. Several compositions for each type of material providing in varying degrees combinations of properties such as low and constant contact resistance, high electrical and thermal conductivity, hardness, resistance to deformation and wear, resistance to erosion from arcing and resistance to sticking.

A: Silver-nickel. Low contact resistance; high ductility; high current carrying capacity. Hardness, cold-worked, up to Rock B 60. Contact rivets, disks, screws, stamped or coined shapes, sheets or wire. For circuit breaker main contacts, contactors, relays, disconnect switches, instruments, slidewire contacts.

NW: Silver-nickel-tungsten. Combines current carrying capacity with medium current interrupting capacity. Contact disks or other stamped shapes. For contactors, switches, relays, and d-c vibrators.

C: Silver-graphite. Highly nonwelding, low contact resistance. Contact disks, stamped or molded shapes. For circuit breakers, and sliding contacts generally.

M: Silver-molybdenum. Heavy current interrupting ability; resists erosion from arcing; hardness up to Rock B 80. Individually molded shapes. For circuit breaker arcing tips; contactors operated under oil.

W: Silver tungsten. Heavy current interrupting ability; highly resistant to erosion from arcing; high conductivity; hardness up to Rock B 100; Individually molded shapes. Some grades for contacts in small circuit breakers such as household breakers. Other grades for heavy-duty circuit breaker arcing tips operating in air.

UW: Copper tungsten; high current-interrupting capacity; wear resistant; hardness to Rock B95. Molded parts to specification. For air circuit-breaker arcing contacts and arc runners. Particularly suitable for oil-immersed applications such as tap changers (under load), heavy-duty contactors, circuit breakers. Also for resistance welding electrode tips.

UT: Copper tungsten carbide; hard (to Rock B100); wear resistant. Molded parts to specification. Outstanding for oil-immersed sliding contact applications, such as tap changers (under load), circuit breakers. Also for welding electrode facings.

GLACIER (Bearing babbitt)—Glacier Metal Co., Richmond, Va.

Antifriction metal: Ingots. Recommended pouring temperature, 600 F; bhn, 24.1; load to reduce height of test piece by 0.001-in., 4599 psi; load required to compress test piece 50% of original height, 26,118 psi; sp gr, 9.976; wt, lb per cu in., 0.359.

Genuine Sovereign babbitt: Ys, 5 tons per sq in., elong in 2 in., 16.7%; bhn, 28.4; load to reduce height of test piece by 0.001-in., 9800 psi; sp gr, 7.327; wt, lb per cu in. 0.263; pouring temperature, 800 F. For bearings.

GLASTIC (Thermosetting polyester plastics) — Laminated Plastics, Inc., Cleveland 3, O.

Laminated sheets and molded shapes.

Grade GU: Flex str, 72,500 psi; imp str (Izod) 46.0 ft-lb; ts, 70,000 psi; compr str, 30,500 psi; Rock hdns, M90; sp gr 1.55; dielectric str, 300 volts per mil; resistant to outdoor exposure, hydrocarbons, moderate acids, chrome plating acids, nickel plating acids, acetone (intermittent), mild alkalies. These properties apply to material ⅛-in. thick.

Grade GW: Flex str, 52,000 psi; imp str (Izod), 25.4 ft-lb; ts, 44,500 psi; compr str, 25,400 psi; Rock hdns, M 90; dielectric str, 300 volts per mil; corrosion resistance same as for Grade GU. These properties apply to material ⅛-in. thick.

Grade GF: Flex str, 30,500 psi; imp str (Izod), 21.0; ts, 18,000 psi; compr str, 15,500 psi; Rock hdns, M 90; sp gr, 1.55; water absorp, 0.38%; dielectric str, 300 volts per mil; corrosion resistance same as for Grade GU. These properties apply to material ⅛-in. thick.

Grade MM: Flex str, 23,800 psi; imp str (Izod), 13.5 ft-lb; ts, 11,100 psi; compr str, 33,500 psi; Rock hdns, M 90; sp gr, 1.59; dielectric str, 300 volts per mil; corrosion resistance same as Grade GU. These properties apply to material ⅛-in. thick.

Grade A-Flex: Flexible, creasible sheet. Ts, 5-11,000 psi; dielectric str, 600-700 volts per mil; varnishable; storable; 0.015-0.020-in. thick.

GLOBE (Seamless steel tubing) — Globe Steel Tubes Co., Milwaukee 46.

Carbon steel tubes in low and medium carbon for mechanical purposes. Hot-finished and cold-drawn to wide range of sizes; also annealed or cold-drawn stress relieved to higher physicals for strength and machinability.

Carbon seamless steel pressure tubing in low and medium carbon for boiler, condenser, heat exchanger tubes, straight and formed.

Alloy seamless steel tubing in low and medium carbon in SAE and NE grades for mechanical and aircraft tubing; in regular and magnaflux quality. Intermediate alloys such as 5-9% Cr-Mo for petroleum industry.

Stainless seamless tubing in austenitic 18-8 types. Low carbon Type 304, stabilized Types 321 and 347 for welding and maximum corrosion and heat resistance; for dairy, food, chemical industries. Types 329 and 443 for corrosion resistance in specific applications in chemical and textile fields. Straight chrome Types 410 for heat treating where high tensile and toughness with mild corrosion resistance is required. Type 430 for chemical service, especially nitric acid; also for heat resistance applications. Type 446 for high temperature service where load carrying requirements are not severe; resistance to high sulphur atmospheres, good. Used where nickel bearing grades are objectionable. For further data on properties and applications, see "Stainless Steels" listing at end of this section.

GLOBEIRON (Seamless ingot iron tubing) — Globe Steel Tubes Co., Milwaukee 46.

High purity ingot iron in seamless tubing providing high magnetic permeability for electrical purposes. Offers some corrosion resistance in certain special cases because it approaches pure iron.

GLOWELD (Stainless steel welded tubing) — Globe Steel Tubes Co., Milwaukee 46.

Stainless welded tubing in many AISI Types. For property and application data, see "Stainless Steels" listing at end of this section.

GLYCO (Babbitt)—Joseph T. Ryerson & Son Inc., Chicago 80.

Turbo-Glyco: Bearings for high-speed, heavy duty; avg bhn, 30-32.

Marine Glyco: Bearings for electric motor and marine work; avg bhn 27-29.

Standard Glyco: Free flowing, general purpose babbitt; avg bhn, 24.

Heavy pressure mill Glyco: High resistance to crushing loads; high bearing temperatures, avg bhn, 24-26.

Transmission Glyco: For line shafting and transmission work; avg bhn, 22-23.

GOLD ANCHOR (Drill rod) — Anchor Drawn

C 0.70, W 18, Cr 4, V 1.00, Si 0.25, Mn 0.25. Oil or air-quenched and double-tempered; Rock hdns C67 max; magnetic; weldability, poor; abrasion resistance, high; max cont serv temp, 1200 F. For dies, high-temperature springs, dowel pins, punches, taps, drills, reamers, dies, etc.

GOOD-RITE (Plasticizers) — B. F. Goodrich Chemical Company, Cleveland 15, Ohio.

Plasticizers for vinyl resins, nitrile rubbers, the cellulosics and other synthetic resins. Characterized by imparting flexibility to compounds over a wide temperature range, the two current estertype plasticizers are substantially odorless and colorless. Good-rite GP 261 is an odor and color free dioctyl phtalate of extremely low volatility. It possesses excellent electrical properties, excellent heat and light stability and the valuable property of low water extraction. Good-rite GP 233 is an odorless and clear dioctyl adipate distinguished by its excellent low temperature properties. It has excellent heat and light stability, excellent efficiency and good electrical properties. These plasticizers are supplied in quantities from 5 gal. cans to tank trucks and tank cars.

GRAC (Lead-base graphitized babbitt)—Graphitized Alloy Corp., New York 7.

Approx Sn 10, Sb 15, Cd-Cu-Arsenic in small amounts, Pb balance.

Pig or ingot. Comp str at room temperature, 7900 psi; ys, 15,000 psi; bhn at room temperature, approx 27; nonmagnetic; machinability, good; max cont serv temp, 150 F; abrasion resistance, high. Casting temperature, 800-900 F. For bearings in rolling mills, internal combustion engines, diesel engines, freight car axles, turbine pumps, high lift pumps, high speed locomotives and rock crushers.

GRAKONE (Rubber) — International Packings Corp., Bristol, N. H.—affiliated with Graton & Knight Co., Worcester, Mass.

Oil-resistant rubber in molded forms and sheets. Abrasion resistance, high; resistant to all petroleum products, vegetable oils and fats, alcohols, dilute acids and alkalies, etc. Max cont serv temp, 250 F; flexibility, high; dielectric str, excellent to semi-conductive; ts, 3500 psi max; elongation, 100 to 800; moisture absorp, low; in black; sp gr, 1.15-1.45; opaque; Shore hdns, A30-D65. Used as sealing element for reciprocating, static or revolving shafts, hydraulic seals, pneumatic packings, gaskets, and specialties.

GRAMIX (Porous metals)—United States Graphite Co., Saginaw, Mich.

No. 81: Sintered bronze. In porous metal bearings and mechanical shapes; ts, 15,000 psi; compr force to cause 0.001-in. permanent set, 10,000 psi; apparent density, 6.4-6.6 grams per cu-cm; oil absorp (by volume), 20-30%; coef of thermal exp'n (70-200 F), .00000934 in./in./degree F.

No. 86: Sintered iron. As porous metal bear-

ings and mechanical shapes; ts, 20,000 psi; compr force to cause 0.001-in. permanent set, 16,000 psi; apparent density, 5.8-6.1 grams per cu-cm; oil absorp, (bu volume), 15-20%; coef of thermal exp'n, (70-200 F), .0000071 in./in./degree F.

GRANADA (Tool steels)—Crucible Steel Co. of America, New York.

Carbon tool steel: C 1.00, Mn 0.30, Si 0.25. Electric furnace melted water hardening tool steel for general shop applications. Rock hdns (quenched in brine from 1450 and tempered 2 hours) at 212 F, C65-67 at 800 F, C42-44. For tools, dies, bushings, arbors, dowel pins.

Vanadium Tool Steel: C 1.00, Va 0.20. Electric furnace melted shallow hardening tool steel for general shop application. Rock hdns same as carbon tool steel. Typical application same as carbon tool steel.

GRAPH-AL (Alloy tool steel)—Timken Steel & Tube Div., Timken Roller Bearing Co., Canton 6, Ohio.

C 1.50 avg, Si 0.30 max, Mn 0.30 max, P and S 0.25 max, Al 0.12-0.20. Rough bars or billets, finished rods or bars, straight and coiled strip, wire, sheet, plate and forgings, for machining, hot and cold working, brazing, and arc, gas and resistance welding. For annealing, normalize 1700 F; furnace-cool from 1380-1150 F; quench 1450-1500 F into brine. Properties annealed: Ts, 105,000 psi; ys, 53,000 psi; elong in 2 in., 15.5%; impact str (Izod), 120+ ft-lb; Rock hdns (quenched), C67-68; weldability, good; abrasion resistance, high. Contains graphitic carbon. For applications requiring high impact resistance such as swaging rolls, etc

GRAPHALLOY (Carbon-graphite metal-impregnated materials)—Graphite Metallizing Corp., Yonkers 3, N. Y.

Babbitt: Carbon-graphite metal-impregnated with babbitt. Rough bars, finished rods and bars, for machining. Properties, untreated: Ts, approx 5000 psi; comp str, 18,400-23,100 psi; hardness (Shore scler), 45-61; nonmagnetic; max cont serv temp, 300 F. For oilless bushings.

Copper: Carbon-graphite metal-impregnated with copper. Rough bars, finished rods and bars, for machining. Properties untreated: Ts, 5000 psi; comp str, 19,200-24,500 psi; hardness. (Shore scler), 48-63; nonmagnetic; max cont serv temp, 700 F. For oilless bushings and motor brushes.

Cadmium: Carbon-graphite metal-impregnated with cadmium. Rough bars, finished rods and bars, for machining. Properties untreated: Ts, 4000-5000 psi; comp str, 18,000-20,000 psi; hardness, (Shore scler), 45-61; max cont serv temp, 250 F. For oilless bushings and electric contacts.

GRAPHITAR (Carbon-graphite)—United States Graphite Co., Saginaw, Mich.

For bearings, thrust washers, seals, rotor vanes, etc., made in several grades of which the following is typical. Comp str, 22,000 psi; apparent density (gr per cu cm), 1.77; trans breaking str, 10,500 psi; hardness, scler, 85; coef of thermal exp'n, 75-620 F (in./in./degree F). 0.0000015.

GRAPH—M.N.S. (Alloy tool steel)—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O.

C 1.5, Mn 1.25, P 0.025 max, S 0.025 max, Si 1, Ni 1.75, Mo 0.5, Cr 0.5. Hot-rolled bars and billets, finished rods and bars, wire, sheets, strip plates and forgings. When used as cold-forming metal: abrasion resistance, high; nonscuffing. Ts (annealed), 135,000 psi; ductility, medium; weldability, good; bhn (annealed), 241; (heat-treated), 682. Contains graphitic carbon. For various types of machine parts, having light walls and non-uniform sections as well as cold-working dies and tools.

GRAPH-MO (Alloy tool steel)—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, O.

C 1.5, Si 0.8, Mn 0.4, P and S 0.025 max, Mo 0.25. Hot-rolled bars or billets, finished rods or bars, wire, strips, sheets, plates and forgings. Abrasion resistance, high; ts, 85,000 psi, min; ductility ,medium; bearing properties, fair; weldability, good; nonscuffing properties, fair bhn (annealed), 197; (heat-treated), 745. Contains graphitic carbon. For jigs, fixtures, dies and tools. All parts requiring resistance to wear and nonscuffing properties.

GRAPHO (Babbitt metal)—Lehigh Babbitt Co., Allentown, Pa.

Babbitt metal of different grades, mixed with graphite; can be poured as regular metal without losing graphite content. Mechanical properties similar to those of other babbitt metals. For bearings.

GRAPH-TUNG (Alloy tool steel)—Timken Steel & Tube Div., Timken Roller Bearing Co., Canton 6, Ohio

C 1.50 avg, Si 0.65 avg, Mn 0.50 max, Mo 0.50 avg, W 2.80 avg. Rough bars or billets, finished rods or bars, straight strip, wire, sheet, plate, and forgings, for machining, hot and cold working, brazing, and arc, gas and resistance welding. Weldability, good; abrasion resistance, high. Contains graphitic carbon. For parts requiring maximum wear resistance.

GRATON & KNIGHT (Mechanical leathers) — Graton & Knight Co., Worcester 4, Mass.

Vegetable, mineral or combination tan leathers furnished for molding. Abrasion resistance, high; resistant to most petroleum products, vegetable and animal fats and oils, and many organic solvents. Max cont serv temp, 130-190 F depending on moisture and service condition; inflammable; flexibility, high; ts, 5000 psi avg; elongation, up to 50%; moisture absorp, low in natural color; sp gr, 0.95-0.99. For hydraulic, pneumatic and vacuum sealing members for either rotating, reciprocating or static machine members. Material can be made to possess an extremely low coefficient of friction.

GUMMON (Cold-molded thermosetting plastics) —Garfield Mfg. Co., Garfield, N. J.

Black, cold-rolled, corrosion and heat-resistant (450 F); dielectric strength, high; high polish; resistant to hot oil. Will not shrink, crack, warp or deteriorate with age; nonflammable. Used for insulated parts, etc.

GUNITE (Cast irons and cast steels)—Gunite Foundries Corp., Rockford, Ill.

Processed cast irons as follows:

A: Properties, untreated: Ts, 40,000 psi, bhn, 223.

A-1: Oil quench for bhn over 400. Properties, untreated: Ts, 40,000 psi; bhn, 223.

B-1: Oil quench for high hardness. Properties, untreated: Ts, 50,000 psi; bhn, 255.

C: Properties, untreated: Ts, 35,000 psi; bhn, 212.

D: Oil-quench for high hardness. Properties, untreated: Ts, 45,000 psi; bhn, 248.

E: Oil-quench for high hardness. Properties, untreated: Ts, 45,000 psi; bhn, 229.

E-1: Oil-quench for high hardness. Properties, untreated: Ts, 40,000 psi; bhn, 223.

F: Oil-quench for high hardness. Properties, untreated: Ts, 50,000 psi; bhn, 262.

R: Oil-quench for high hardness. Properties, untreated: Ts, 50,000 psi; bhn, 269.

S: Oil-quench for high hardness. Properties, untreated: Ts, 45,000 psi; bhn, 248.

Also standard ASTM grade malleable irons as follows:

35018: Castings. Properties, annealed: Ts, 53,000 psi; ys, 35,000 psi; elong in 2 in., 18% min; bhn, 130.

32510: Malleable castings. Properties, annealed: Ts, 50,000 psi; ys, 32,500 psi; elong in 2 in., 10% min.

50004: Pearlitic malleable iron castings. Properties, heat-treated: Ts, 80,000 psi; ys, 50,000 psi; elong in 2 in., 4% min; bhn, 207.

Cast steels available as follows:

30-70: Properties, heat-treated: Ts, 70,000 psi min; ys, 35,000 psi min; elong in 2 in., 24% min; bhn, 150.

45-80: Properties, heat-treated: Ts, 80,000 psi min; ys, 40,000 psi min; elong in 2 in., 17% min; bhn, 170.

32X105: Properties, heat-treated: Ts, 105,000 psi min; ys, 85,000 psi min; elong in 2 in. 15% min; bhn, 217.

45-200: Oil-quenching steel having high hardenability. Recommended for heavy-section castings where bhn of 241 up to 600 are required. Hardness depends upon tempering temperature as do mechanical properties.

HANDY FLUX (Brazing flux)—Handy & Harman, New York 7.

For brazing iron, steel, stainless steel, Monel metal, nickel, copper, beryllium-copper, brass, bronze, aluminum-bronze and various other ferrous and nonferrous metals and alloys. Liquid and active at 1100 F.

HAN-OMATIC (Contact electrode for lighter gauges)—Eutectic Welding Alloys Corp., New York 13.

HARCHROME (Welding rod) — Harnischfeger Corp., Milwaukee 14, Wis.

5 Cr: Stainless steel welding rods for joining chromium steels. Ts of joints, 100-120,000 psi. For welding Types 501 and 502 straight chromium steels.

9 Cr: Stainless steel welding rods for joining chromium steels. Ts of joints, 70-80,000 psi; joints resist corrosion caused by chemicals and oxidation. For welding Type 410 straight chromium steels.

16 Cr: Stainless steel welding rods for joining chromium steels. Ts of joints, 70-85,000 psi. For welding Type 430 straight chromium steels; also for welding of parts subjected to temperatures up to 1550 F.

HARCOTE (Welding rod)—Harnischfeger Corp., Milwaukee 14, Wis.

20: Bhn of deposit, 200-255. For producing medium-carbon welds which are machinable and flame hardenable. Typical applications: Building up engine slides, shaft bearings, motor shafts and gear hub faces.

35: Bhn of deposit, 285-375. For surfacing low and high-carbon and alloy steels which are resistant to shock and abrasion and are flame hardenable. Typical applications: Chain sprockets, gears, car wheels, drill bits and rail ends, etc.

HARDALLOY (Arc welding rod)—McKay Co., The, Pittsburgh 22, Pa.

Chromium-molybdenum air-hardening steel arc welding electrode for hard surfacing of steel. Bhn of deposit, 550-620; corrosion resistance better than mild steel. Hard as deposited; can be annealed and rehardened; good impact resistance. For hard surfacing cams, clutch parts, chuck jaws, dogs, guides, rollers, etc.

HARDEX (Welding electrodes)—Metal & Thermit Corp., New York 5.

Hard surfacing electrodes. Ac or dc; deposits are air hardening, combine great toughness with hardness. Can be used on wide range of mild steels, high-carbon steels and manganese steels. Four grades are:

No. 20: Bhn of deposit, approx 200.

No. 25: Bhn of deposit, approx 250.

No. 25: Bhn of deposit, approx 450.

No. 60: Bhn of deposit, approx 600.

HARDWELD (Welding electrode)—Lincoln Electric Co., Cleveland.

Type 100: High-carbon arc welding electrode having bhn of 225-488. Provides dense, tough surface of moderate hardness to enable various steel parts to resist shock and abrasion. For locomotive or crane tire flanges, etc.

Type 50: Medium-carbon steel electrode for building up steel parts and surfaces. Deposit has considerable resistance to deformation and wear, and is machinable at slow speed. Coating stabilizes arc and permits deposition of tough, dense medium-carbon steel. Hardness (deposited on straight-carbon steel and allowed to cool naturally), 20 to 35 Rockwell C.

HARDY (Metal powders)—Charles Hardy Inc., New York 17.

Metal powders of various kinds including aluminum, brass, copper, iron, tungsten, tungsten carbide, manganese, nickel, etc.; available commercially; when compressed into parts give physical properties approaching those of metals or alloys produced by melting and casting, and some properties unattainable by other means. Company provides laboratory and engineering advisory service.

HARDYNE (Permanent magnet powder) — Charles Hardy Inc., New York 17.

May be pressed to form complex shapes obtainable by powder metallurgy; parts so produced require no sintering. Among its uses are speedometer, pickup and instrument magnets, magnetic recording tape, etc.

HARMOMANG (Welding rods) — Harnischfeger Corp., Milwaukee 14, Wis.

A: Bhn of deposit, 429-459. For building up welds subject to impact and abrasion on Mn-Mo steel. Typical applications: Rock crusher parts, excavator parts, railway frogs and switches, dredge parts, rolling mill equipment, mining machinery, etc.

B: Bhn of deposit, 429-459. For building up welds subject to impact and abrasion on Mn-Mo steel. Typical applications: Rock crusher parts, excavator parts, rail ends, mining machinery, dredge parts, rolling mill equipment, road grading equipment, railway frogs and switches, etc.

HARNIMANG (Welding rod) — Harnischfeger Corp., Milwaukee 14, Wis.

A: Bhn of deposit, 429-459. For building up welds requiring high tensile strength and ductility.

B: Bhn of deposit, 429-459. For building welds requiring high tensile strength and ductility.

HARRIS 80-10-10 (Copper-tin alloy) — Arthur Harris & Co., Chicago 7.

Cu 80, Sn 10, Pb 10. Sand castings. Used for bearings and pressure castings.

HARRIS SILENTBLOC (Metal-rubber composition)—Harris Products Co., Cleveland, O.

Metal combined with natural or synthetic rubber for mountings and bearings. Used for machine mounts to control vibration, oscillating or torque joints, spring-shackle bushings. Applications include automotive, farm machinery, aircraft, railroad, and electrical equipment, etc.

HARSTAIN (Welding rods) — Harnischfeger Corp., Milwaukee 14, Wis.

18-8: 18-8 stainless steel welding rods for joining stainless steels. Ts of joints, 80-90,000 psi; ys of joints, 50-55,000 psi. For welding stainless steels of Types 301, 302, 304, 305, 306 and 308.

18-8 Cb: Stainless steel welding rods for joining stainless steels. Ts of joints, 85-90,000 psi; ys, 55,000 psi. For welding stainless steels of Type 301, 302, 304, 305, 308 and 347.

18-8 2 Mo: Stainless steel welding rods for joining stainless steels. Ts, 80-90,000 psi; joints resist corrosion caused by acids, liquors and brines. For welding Type 316 stainless steels.

18-8 3 Mo: Stainless steel welding rods for joining stainless steels. Ts of joints, 80-90,000 psi; joints resist corrosion caused by acids, liquors and brines. For welding Type 317 stainless steels.

25-12: Stainless steel welding rods for joining stainless steels and for joining stainless steels to mild steels. Ts of joints, 85-90,-000 psi; ys, 50-55,000 psi. For welding Type 309 and other similar steels of low alloy content that are subject to high temperatures.

25-20: Stainless steel welding rods for joining stainless steels to mild steels. Ts of joints, 85-90,000 psi: ys, 50-55,000 psi. For welding Type 309 and 310 stainless steels and straight chromium steels. For general-purpose welding where cracking is a problem.

A25-20: Stainless steel welding rods for joining stainless steels and for joining stainless steels to mild steels. Ts, 85-90,000 psi; ys, 50-55,000 psi. For welding Type 310 stainless steels and for general-purpose welding where cracking is a problem.

HARTOP (Welding rods)—Harnischfeger Corp., Milwaukee 14, Wis.

Red: Bhn of deposit, 495-555. Excellent resistance to impact and abrasion. For grader blades, plow shares, plow disks, grinder rings, tractor cleats, bulldozer tips, etc.

Yellow: Bhn of deposit, 601-653; excellent resistance to flat impact and abrasion. For latch bars and keepers, ball joints, crane hooks, chuck jaws, chain links and pins, etc.

Brown: Bhn of deposit, 331-375; excellent resistance to shock and abrasion. For crawler track rails, crawler pads, rollers, idlers and clutches, etc.

Green: Bhn of deposit, 429-495; for general all-purpose hard surfacing. For crusher jaws, conveyor buckets, grizzly bars, etc.

HARTUNG (Welding rods) — Harnischfeger Corp., Milwaukee 14, Wis.

Bhn of deposit, 550-670. For hard surfacing and building up cutting tool edges.

HARVEL (Insulating varnishes)—Irvington Varnish & Insulator Co., Irvington, N. J.

Special phenol - formaldehyde, polymerization type varnishes. Exceptional penetrating power; excellent electrical properties; noncorrosive; unusual resistance to acids, dilute alkalies, moisture, lubricating and transformer oil; save baking time required; harden by polymerization rather than oxidation and cure to infusible nonthermoplastic state. For use with any type of insulation. Also oleoresinous types in clear and black, air-drying, baking.

Oil stop: Oilproof, waterproof, heat-resistant, phenol-aldehyde used in splicing electrical cables; to seal and insulate electrical coils. Applied as a viscous liquid, it hardens by polymerization to an infusible, nonthermoplastic state; adheres to rubber, oil-impregnated paper, varnished cambric, fiber, bakelite and copper.

HASCOLOY (Cast steel)—Hanford Foundry Co., San Bernardino, Calif.

Ni-Cr-Mo sand castings to specification. Properties heat-treated: Ts, 120,000 psi; ys, 85,000 psi; elong in 2 in., 17%; imp str (Charpy), 25 ft lb; bhn, 225-250; machinability, fair; weldability, fair; abrasion resistance, medium. For highly stressed gears and pressure castings.

HASCROME (Hard facing rods) — Haynes Stellite Div., Union Carbide and Carbon Corp., Ind.

Cr 10-14, C 0.80-1.20, Mn 3-5, Fe balance. For hard facing parts subject to abrasion and impact, and castings to resist abrasion and impact.

HASKELITE (Plywood)—Haskelite Mfg. Corp., Grand Rapids 2, Mich.

Resin-bonded plywood. Light weight; high strength; elastic; moldable to desired forms and shapes. For airplanes, buses, railways, radio cabinets and speakers, passenger cars, etc.

HASTELLOY (Nickel-base alloys)—Haynes Stellite Div., Union Carbide and Carbon Corp., Ind.

A: C 0.02-0.12, Mo 17-21, Fe 17-21, Ni balance. Rough bars, finished rods or bars, straight strip, welded tubing, wire, sheet, plate, and as sand castings. Properties, as cast: Ts, 69-78,000 psi; ys, 42,500-45,000 psi; elong, 8-12%; bhn, 155-200; impact str, 2535 ft-lb (Izod). Properties, rolled, annealed: Ts, 110-120,000 psi; ys, 47-52,000 psi; elong, 40-48%; bhn, 200-215. For all types of chemical equipment, coils, vessels, heat exchangers, etc.

B: Mo 24-32, Fe 3-7, C 0.02-0.12, Ni balance. Rough bars, finished rods or bars, straight strip, welded tubing, wire, sheet, plate and castings. Properties, as cast: Ts, 75-82,000 psi; ys, 55-57,000 psi; elong, 6-9%; Rock hdns, B92-99. Properties, rolled-annealed: Ts, 130-140,000 psi; ys, 60-65,000 psi; elong, 40-45%; Rock hdns, B96-100; sp gr, 9.24; abrasion resistance, medium. For all types of chemical equipment and turbine blading.

C: Mo 14-19, Fe 4-8, C 0.04-0.15, Cr 12-16, W 3-5.5, Ni balance. Rough bars, finished rods or bars, welded tubing, wire, sheet, plate and castings. Properties, as cast: Ts, 72-80,000 psi; ys, 45-48,000 psi; elong in 2 in., 10-15%; Rock hdns, B89-97. Properties, rolled annealed: Ts, 115-128,000 psi; ys, 55-65,000 psi; elong in 2 in., 25-50%; Rock hdns, C50-55; sp gr, 8.94; max cont serv temp, 2000 F; abrasion resistance, medium. For all types of chemical equipment, also exhaust gas systems for aircraft, heat-treat furnace parts, and carburizing-furnace parts.

D: Si 11, Cu 2-5, Al 1 max, Ni balance. Castings and cast welding rod. Properties, unheat-treated: Ts, 36-40,500 psi; Rock hdns, C50-55, sp gr, 7.80; nonmagnetic; max cont serv temp, 1200 F; abrasion resistance, high. For equipment for handling hot sulphuric acid, also for wear parts such as sleeves, bushings, etc.

HAVEG 41, 48, 60 (Furane and phenolic thermosetting plastics)—Haveg Corp., Newark 23, Del.

Sheets, rods and tubes, for compression molding and casting. Abrasion resistance, medium; resistant to acids, alkalies and solvents; max cont serv temp, 300 F. Principally used for process equipment such as tanks, valves, pumps, pipe, fans, fume ducts, etc.

HAYNES (Iron-base hardfacing rods)—Haynes Stellite Div., Union Carbide and Carbon Corp., Ind.

90: Welding rods of chromium and carbon in an iron base for hard-facing steel, stainless steel and cast iron. Ts of joints, 55-75,000 psi; bhn of joints, 555-578. For hardfacing shredding machine parts, clam shell buckets, lifting hooks, cement guns, crusher rolls, pump plungers, brick and tile die liners, crane tongs and dogs, mixer parts, etc.

92: Welding rods of Mo, Mn, Si, Cr, C and iron base. Ts of joints, 25,000 psi; bhn of joints, 712. For hardfacing parts such as pugmill knives, end plates, plow shares, suction-fan blades, sub-soil teeth, hand trucks, scrapers, etc.

93: Fe 15-19, Co 4-7, V 0.5-3 Mo 13-17, Fe balance. Cast welding rod. As cast: Ts, 43,000 psi; comp str, 407,800 psi; Rock hdns, C62 as deposited, gas welded. In heat-treated state: Ts, 34,700 psi; comp str, 285,300 psi; Rock hdns, gas welded, heat-treated, C66-67; arc welded, heat treated, 63-64. For hardfacing where high cold hardness is necessary and corrosion is not important factor; for applications which tend to grind away a metallic surface, such as dredge pump impellers, cement clinker crusher rolls, etc.

HAYNES Alloys (Cobalt-base alloys) — Haynes Stellite Div., Union Carbide and Carbon Corp., Ind.

No. 25: Cr 18, W 15, Ni 10 (low carbon). Finished rods or bars, straight and coiled strip, tubing, wire, sheet and plate. Properties, heat-treated: Ts, 155,000 psi; compr str, 65,000 psi; ys, 70,000 psi; elong in 2 in., 50% min; Rock hdns, B95; sp gr, 8.15; nonmagnetic; machinability, fair; weldability, good; max cont serv temp, 2000 F; abrasion resistance, medium. For high-temperature service (1700-1800 F). Typical applications: Turbine blades, disks, combustion chambers, jet stacks, jet inner and outer cones, etc.

No. 36: Cr 17.5-19.5, W 14.0-15.0, Ni 9.0-11.0, C 0.35-0.65, Mn 1.0-1.5, B 0.01-0.05, Co balance. Precision castings. Properties (heat-treated): Ts, 125,000 psi; ys, 108,500 psi; elong in 2 in., 1.7%; impact str (Charpy), 6.4 ft-lb; Rock hdns, C37-38. Resists corrosion caused by oxidation up to 2100 F; max cont serv temp, 2100 F; excellent creep and rupture properties; good hot ductility. For turbo charger buckets, turbine buckets, nozzle vanes, etc.

HAYNES STELLITE (Co-Cr-W welding rods and castings)—Haynes Stellite Div., Union Carbide and Carbon Corp., Ind.

1: Cr 28-34, W 11-15, Co balance. Cast hardfacing rods. In untreated state: Ts, 47,000 psi; comp str, 256,000 psi; Rock hdns, C54 (gas welded) and 45 (arc welded); sp gr, 8.59; nonmagnetic; max cont serv temp, 2000 F; abrasion resistance, high. For hardfacing farm implements, screw conveyors, mixing machine plows, bed plates, guides, cams, scrapers, stripping knives, and other applications requiring resistance to heat, abrasion and corrosion or combinations of these, and where only moderate shock is encountered.

6: Cr 25-31, W 3-6, Co balance. Hardfacing rod. Ts, 105,000 psi; comp str, 220,000 psi; elong in 2 in., 1%; Rock hdns, C40-46; sp gr, 8.38; nonmagnetic; weldability, good; max cont serv temp, 2000 F. For valves, disk gates and plugs for steam, gas (H_2O), knives, strippers, rolls, shafts, sleeves, etc., where heat, abrasion and corrosion resistance are required, and where more ductility and shock resistance are needed than provided by Alloy No. 1.

12: Cr 26-32, W 6-10, Co balance. Hardfacing rod and castings. In untreated state: Ts, 76,000 psi; comp str, 193,000 psi; Rock hdns, as cast, C46-58, as deposited, gas, 48; sp gr, 8.40; nonmagnetic; max cont serv temp, 2000 F. For guides, hammers and other applications similar to those given for Nos. 1 and 6, but where higher strength and abrasion resistance is required.

21: C 0.20-0.35, Cr 25-30, Ni 1.50-3.5, Mo 4.5-6.5, Fe 2 max. Sheets and sand and precision castings, for hot working, brazing and arc, gas and resistance welding. In untreated state: Ts, 101,300 psi; ys, 82,300 psi; elong in 2 in., 8.2% Rock hdns, C28-32; sp gr, 8.30; nonmagnetic; max cont serv temp, 2000 F; abrasion resistance, high; good long-time properties at elevated temperatures. Endurance strength in alternate bending at 120 cycles per second as 10^8 cycles, room temp, 35-40,000 psi; at 1200 F, 44,000 psi; and at 1500 F, 33,000 psi. For turbine blading, exhaust systems for aircraft and other high-temperature applications.

23: C 0.35-0.50, Cr 23-29, Ni 1.50 max, W 4-7, Fe 2 max, Co balance. Sheets and castings, for hot working, brazing arc, gas and resistance welding. In untreated state: Ts, 105,400 psi; ys, 58,400 psi; elong in 2 in., 7%; Rock hdns, C28-32; sp gr, 8.54; nonmagnetic; resists corrosion caused by high-temperature oxidation and exhaust gases; max cont serv temp, 2000 F; abrasion resistance, medium. For turbine blading and other high-temperature applications. Good long-time properties at elevated temperatures.

27: C 0.35-0.50, Cr 23-29, Mo 5-7, Fe 2 max, Co 30 min, Ni balance. Sheet and castings, for hot working, brazing, and arc, gas and resistance welding. In untreated state: Ts, 82,500 psi; ys, 46,900 psi; elong in 2 in., 7%; Rock hdns, C17-22, sp gr, 8.21; nonmagnetic; resists corrosion caused by high-temperature oxidation and exhaust gases; max cont serv temp, 2000 F; abrasion resistance, medium. Good long-time elevated-temperature properties. Endurance strength in alternate bend at 120 cycles per second at 10^8 cycles, at 1200 F, 41,000 psi; at 1500 F, 38,000 psi. For turbine blading and other high-temperature applications.

30: C 0.35-0.50, Cr 23-29, Ni 13-17, Mo 5-7, Fe 2 max, Co balance. Furnished in sheets and castings, for hot working, brazing and arc, gas and resistance welding. In untreated state: Ts, 100,000 psi; ys, 65,000 psi; elong in 2 in., 6 per cent; hardness, rockwell C, 28-32; sp gr, 8.31; resists corrosion caused by high-temperature oxidation and exhaust gases; max cont serv temp, 2000 F; abrasion resistance, high. Excellent long-time properties at elevated temperatures. Endurance strength in alternate bend at 120 cycles per second at 10^8 cycles, at 1200 F, 41,000 psi; at 1500 F, 38,000 psi. For turbine blading and other high-temperature applications.

31: C 0.45-0.60, Cr 23-28, Ni 9-12, W 6-9, Fe 1.50 max, Co balance. Sheets and castings; for hot working, brazing, and arc,

gas and resistance welding. In untreated state: Ts, 101,000 psi; ys, 74,100 psi; elong in 2 in., 11%; sp gr, 8.61; resists corrosion caused by high-temperature oxidation and exhaust gases; max cont serv temp, 2000 F; abrasion resistance, high. Excellent long-time properties at elevated temperatures. Endurance strength in alternate bend at 120 cycles per second at 10^8 cycles; at 1200 F, 41,000 psi; at 1500 F, 38,000 psi. For turbine blading, etc.

98M2: Cr 27-31, W 16-19, Co balance. Castings. In untreated state: Ts, 63,000 psi; Rock hdns, C62-64; nonmagnetic; resists corrosion caused by high-temperature oxidation; max cont serv temp, 1800 F; abrasion resistance, high. For metal-cutting tools, for cast iron, steels, nonferrous alloys and nonmetallic materials; gages, bushings and special castings requiring resistance to heat, abrasion and corrosion, or combinations of these.

Star-J Metal: Cr 29-34, W 15-19, Co balance. Castings. In untreated form: Ts, 65,000 psi; as cast, Rock hdns, C58-62; sp gr, 8.76; nonmagnetic; weldability, good; resists corrosion of all atmospheric conditions including brine, also 10% boiling HNO_3, boiling acetic and ferric sulphate, and 10% solutions of ferric chlorides; max cont serv temp, 2000 F; abrasion resistance, high. For metal cutting tools, gages, valves and seats, bushings, guide rolls, cam followers, and other special castings requiring resistance to heat, abrasion and corrosion, or combination of these encountering only moderate shock or impact where maximum hardness is required.

HAYSTELLITE (Tungsten-carbide welding rod)—Haynes Stellite Div., Union Carbide and Carbon Corp., Ind.

Hard grade: W 90-96, C 3.50-4.50 and Co 0.50-2.00. In untreated state: Rock hdns, A82-88, as deposited; abrasion resistance, high. For oil well drilling tools, rock bits, farm implements, earth moving equipment and other applications where utmost resistance to abrasion is necessary.

Tough grade: W 79-85, C 3.50-4.50 and Co 8-11. In untreated state: Rock hdns, A82-88; abrasion resistance, high. For oil well drilling tools, earth moving equipment, pulverizing hammers, and other applications where abrasion resistance is required.

HECLA (Bronze)—Titan Metal Mfg. Co., Bellefonte, Pa.

Cu 60, Pb 0.80, Sn 0.75, Zn balance. Ts, 69,000 psi; ys, 30,000 psi; elong, 32%; Rock hdns, B75; machinability, good; corrosion resistant; sea-water resistance, good.

HEMIT (Cold-molded refractory material)—Garfield Mfg. Co., Garfield, N. J.

Max cont serv temp, 1500-1750 F; moisture absorp when impregnated, low; dielectric strength, high, nonflammable. For interior parts of heating devices, or where a molded part must withstand an arc.

HEPPENSTALL (Chrome - nickel - molybdenum steel)—Heppenstall Co., Pittsburgh.

2 C 30: Ni-Cr-Mo steel, C 0.3. For shafting where high torsional strength is required.

5 H 50: C 0.5, Cr-Mo and V alloy. Die blocks. Material is heat-resistant, abrasion-resistant; ts and ductility, high. For strip mill rolls, etc.

HERCULES (Plastics)—Hercules Powder Co., Wilmington 99, Del.

Cellulose acetate: Thermoplastic flake and molding powder for injection molding, compression molding, extrusion and blow molding. Abrasion resistance, medium; resists weak acids and alkalies; flex str, 2000-13,000 psi; dielectric str (volts per mil inst), 290-365; ts, 3000-8000 psi; imp str (Izod), 0.7-6.0 ft-lb. Full range of brilliant colors including translucent and transparent color effects; special formulations of flame-resistant acetate are self-extinguishing. Water absorp (24 hr, ⅛-in. thick, %), 1.5-2.9; sp gr, 1.27; machinability, excellent; thermal exp'n (in./in./°C), 10—15x10-$^{-5}$. For small motor housings, handles, wire covering, etc.

Ethyl cellulose: Thermoplastic flake and molding powder for injection molding, compression molding, transfer molding, blow molding and extruding. Resists weak acids and alkalies; max cont serv temp, 115-220 F; flex str (ASTM D650), 3000-12,000 psi; dielectric str (volts per mil, short time, ⅛-in. thick), 400-600; ts, 2000-10,000 psi; compr str, 3000-20,000 psi; imp str (Izod), 2.0-11.5 ft-lb; variety of colors; moisture absorp, low; sp gr, 1.07-1.18; translucent and opaque; machinability, good; bhn, 4-9 (10 kg); coef thermal exp'n 10—14x10-$^{-5}$/°C. Excellent dimensional stability at extremes in temperature and at high humidities. For handles, housings, breaker strips, architectural trim, etc.

HERCULITE (Heat-treated plate glass)—Pittsburgh Plate Glass Co., Pittsburgh 19.

Flat and bent sheets. Corrosion and abrasion resistance, high; heat-resistant to 650 F; flexibility, medium; ts, 29,500 psi; moisture absorp low; nonflammable; sp gr, 2.52; transparent; highly polished. For use as windows or any glass application requiring unusual strength.

HERCULOY (Silicon bronze)—Revere Copper & Brass Inc., New York 17.

No. 420: Corrosion resistance of copper and mechanical properties of mild steel. Properties depending on hardness: Ts, 58-94,000 psi; ys 21-69,000 psi; elong in 2 in., 55-10%; Rock hdns, B60-93; conforms to ASTM specifications. Cold working properties, good; hot working properties, excellent; machinability, fair; weldability, good. Excellent for soldering and good for polishing. For tanks, pressure vessels (steam pressure not to exceed 125 lb), weatherstrips, forgings, conduits, hydraulic pressure lines, etc.

No. 421: Low-silicon Bronze. Cold working properties, excellent; hot working properties, excellent; machinability, fair; weldability, good. Excellent for soldering and good for polishing. Properties, depending on hardness: Ts, 45-70,000 psi; ys, 15-55,000 psi; elong in 2 in., 60-8%; Rock hdns, F60-B80; conforms to ASTM specifications. For cold headed bolts, nuts, screws, lag bolts, hydraulic pressure lines, cable clamps, cotter pins, etc.

HERCULOY (Welding rod)—Revere Copper & Brass Inc., New York 17.

Silicon bronze: For joining silicon bronze sheet and plate, brasses, deoxidized copper sheets steel and galvanized iron. Melting range, 1780-1880 F; joint properties: Ts, 50-55,000 psi; Rock hdns, F70-90. Usable with oxy-acetylene, carbon arc and inert gas shielded arc methods in welding of silicon bronze sheet, plate and with carbon and inert shielded arc methods in welding of brass and copper. Also employed for building up wear resistant overlays on cast iron and steel by carbon and metal arc methods.

HERECROL RC (Self-curing synthetic rubber)—Heresite & Chemical Co., Manitowoc, Wis.

Extremely tough, adherent, smooth glossy coating; resistant to strong mineral acids, alkalies, alcohols, aliphatic hydrocarbons; unaffected by solution temperatures up to 180 F. Recommended for conveying abrasive solutions and where mechanical damage is unavoidable.

HERESITE (Plastic coatings) — Heresite & Chemical Co., Manitowoc, Wis.

P-403 Brown Primer: Heat hardening pure phenolic resinoid coating. Unaffected by most acids and alkalies; insoluble in all solvents; odorless, tasteless and nontoxic; various film thicknesses obtainable; mechanical damage repairable; max cont serv temp, 450 F. Widely used on processing equipment.

Industrial coatings: Combination of P-403 brown primer and L-66 clear. Heat hardening pure phenolic resinoid coating possessing same characteristics as P-403 plus a glass-like film surface. Widely used in rayon and textile industry as well as for lining for vessels, piping, machine parts, blowers and other equipment exposed to various corrosive conditions.

HERESITE (Thermosetting phenol-formaldehyde powder)—Heresite & Chemical Co., Manitowoc, Wis.

No. M-66: Phenol formaldehyde thermosetting plastic powder for compression molding. Abrasion resistance, medium; chemical resistance, high for acids—medium to low for caustics; max cont serv temp, 350 F; flex str, 12,000 psi; dielectric str, 300 volts per mil inst; ts, 7000 psi; comp str, 10,000 psi; impact str (Izod), 0.36 ft-lb; red, amber and green; moisture absorp, low; sp gr, 1.29; transparent; machinability, fair. Provides excellent finish; for dairy equipment, hospital equipment, etc.

HEVIMET (Special alloy)—Carboloy Co. Inc., Special Metals Div., Detroit 32, Mich.

Parts produced by powder metallurgy. Abrasion resistance, high; sp gr, 16.8-17.0; machinability, good; Rock hdns, C30-40; coef thermal exp'n, 5.6 x 10-^{6} in./in./°C. Extremely dense and heavy material used for X-ray absorption screens and balancing weights for crankshafts, airscrews, centrifugal clutches, etc.

HI-DEN (Laminated plastics)—Parkwood Corp., Wakefield, Mass.

Plates for machining. Abrasion resistance, medium; resists weak acids and alkalies; max cont serv temp, 200-250 F; slow burning; rigid; dielectric str, 200-500 (volts per mil inst); ts, 35,000 psi; comp str, 20,000 psi; flex str, 30,000 psi; moisture absorp, low; in amber color; opaque; sp gr, 1.30-1.35; machinability, good. For use wh lightweight and strength are required, s as textile picker sticks, etc. Also for for ing dies for aluminum and light-gage st spinning chucks and assembly fixtures.

HILLS McCANNA (Magnesium and aluminu base alloys)—Hills-McCanna Co., Chicag

Magnesium and aluminum base alloy sa castings.

HIPERCO (Iron-cobalt alloy) — Westingho Electric Corp., East Pittsburgh, Pa.

Approx 1/3 cobalt, 2/3 iron and 1 to 2% another element to increase electrical sistivity. Higher magnetic saturation va and higher permeability at large magneti tion forces than pure iron. Straight str sheet and plate for machining and hot cold forging. In untreated state: Ts, 50,0 psi; ys, 40,000 psi; elong in 2 in., 2-4 sp gr, 8.10. For magnetic parts where hi magnetic saturation value, low core loss a high permeability at high flux densities a desired.

HIPERNIK (Iron-nickel magnetic alloy)—We inghouse Electric Corp., East Pittsburgh, Pa

Magnetic alloy: Ni 49.5, Fe 49.5, Mn 0.1; e tremely ductile. High magnetic perme bility at low and moderate inductions. Pr marily for radio and communication appl cations; for transformer laminations, r lays, radio and current transformers, etc

HIPERNIK V (Iron-nickel magnet alloy)—We inghouse Electric Corp., East Pittsburgh, Pa

Approx composition: Ni 49.5, Fe 49.5, Mn 0. Spirally-wound cores. Very soft and ver ductile. Rectangular hysteresis loop; hig saturation of order of 16 kilogausses. Re sidual inductions, as high as 14.6 kilogaus ses; coercive forces, as low as 0.1 oerste For application to pulse transformers, sa urable reactors, and magnetic amplifiers.

HIPERSIL (Magnetic silicon iron) — Westing house Electric Corp., East Pittsburgh, Pa.

High-permeability silicon iron whose optimu magnetic qualifications exist in the rollin direction. Makes possible lightweight cor construction. Available in finished core form only. For variety of applications in com munications field, including radio and rada transformers, chokes, relays, magnetic am plifiers, reactors, etc. Three grades.

HI-STEEL (Corrosion resistant alloy) — Inlan Steel Co., Chicago 3.

Low-alloy, high-strength steel in plate, sheet strip, structurals and bars. Ts, 70,000 psi ys, 50,000 psi; elong in 2 in., 22%; endur ance limit, 49,000 psi; abrasion resistance high; resistance to atmospheric corrosion high. Suitable for hot or cold working stamping, drawing, brazing, and welding Can be precipitation hardened for higher mechanical properties. For reducing dead weight and increasing payload of equipment such as railroad freight and passenger cars trucks, busses, mine cars, street cars, earth moving machinery, concrete mixers, etc.

HITEST (Cast iron)—The Medart Co., St. Louis

For ordinary cast-iron uses and for cast steel in some applications. Material is corrosion-resistant and has high tensile strength and good machinability.

HOMALITE (Thermosetting plastics) — The Homalite Corp., Wilmington 166, Del.

Type 100: Sheets, rods or tubes, for casting, stamping and machining. Abrasion resistance, high; resistant to dilute acids, alkalies and all organic solvents; max cont serv temp, 300 F; dielectric str, 500 (volts per mil inst); flexibility, low; ts, 5000 psi; flex str, 5000 psi; moisture absorp, low; in all colors; sp gr, 1.21; transparent, translucent, opaque.

Type 200: Sheets for casting. Abrasion resistance, high; chemical resistance, excellent; max cont serv temp, 250 F; dielectric str, 500 (volts per mil inst); ts, 2000 psi; flex str, 3000 psi; in all colors; shatter-proof; sp gr, 1.0; transparent, translucent, opaque.

HORSE HEAD ZAMAK (Zinc die casting alloys)—The New Jersey Zinc Co., New York.

No. 3: Al 4.1, Mg 0.04, balance Horse Head Special zinc.

No. 5: Al 4.1, Cu 1.0, Mg 0.04, balance Horse Head Special zinc.

HOTFORM (Hot-work die steel)—Vanadium Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

Three types 5% Cr: Rough bars or billets, finished rods or bars, sheet, plate, forgings and drill rod, for precision casting, machining, hot and cold working, stamping, drawing and brazing. Properties, heat-treated: Rock hdns, C55-59 max; magnetic; weldability, fair; max cont serv temp, 800-1000

F; qualities, good bearing.

HOYT (Babbitt metal)—National Lead Co., New York 6.

Analysis of material varies according to the bearing application.

H.T.M. (Pearlitic malleable iron) — National Malleable and Steel Castings Co., Cleveland 6, O.

A grade of pearlitic malleable heat-treated to develop great strength and wear resistance.

HUNT-SPILLER GUN IRON (HSGI-Regular, High Test "50" & "60", High Carbon, "L.C.", Di-Iron)—Hunt-Spiller Mfg. Corp., Boston 27.

Air-furnace cast iron sand castings and steel castings to specifications.

HSGI-Regular: Properties, unheat-treated: Ts, 38-40,000 psi; bhn 180-225; alloyed: Ts up to 50,000 psi; bhn to above 300; machinability, good; weldability, good; max cont serv temp, 850 F; wear resistance, excellent.

High Test "50": Ts 50-55,000 psi; bhn 250-290. High Test "60": Ts 60-65,000 psi; bhn 280-350. High Carbon: Tc approx 3.60%; can be alloyed for ts up to 40,000 psi.

"L.C.": Ts, 40,000 psi; bhn, 235-255; max cont serv temp, 1100-1150 F.

Di-Iron: Ts, 50-60,000 psi; bhn 230-290.

Carbon Steels—HS 104: Ts, 65,000 psi min; yield point, 35,000 psi min. Alloy Steel: Ts, 90,000 psi min; yield point, 65,000 psi min.

Uses—Gun Iron (HSGI-Regular & High Test): Cylinder liners, cams, gears, valves, machinery, piston heads, pressure castings, bushings, dies, rings, etc.

HUSSEY (Copper)—C. G. Hussey & Co., Div. of Copper Range Co., Pittsburgh.

Copper sheet, strip, drawn tubing and shapes, wire and rod to specification. Good machinability, weldability and formability. High general corrosion resistance. Excellent for electrical switch parts, bellows, eyelets, deep-drawn parts, trim for appliances, etc. Provides exceptionally good base for plating.

HYCAR (American rubber)—B. F. Goodrich Chemical Co., Cleveland 15, Ohio.

Vulcanizable types of American-made rubber of butadiene and acrylate base in crude sheet, powder and latex forms. Sheets may be compounded into any type of stock desired for further processing by molding, extruding and calendering. Powders may be dry-mill blended with modified phenolic resins either in an internal mixer or on conventional rubber mill with minimum operation cycle.

Type OR-15 (oil-resistant): Vulcanizable American rubber; butadiene-acrylonitrile copolymer. Excellent oil, heat, abrasion and aging resistance; good flex life; ts, 2500-4500 psi; dielectric str, 500 volts per mil; moisture absorp, low; may be compounded in colors, or for blending with vinyl and phenolic resins.

Type OR-25 (oil-resistant): Vulcanizable American rubber; butadiene-acrylonitrile copolymer. Abrasion resistance, high; heat resistant to 300 F; flexibility, high; dielectric str, 500 volts per mil; ts, 2000-3500 psi; moisture absorp, low. Available in easy-processing type, Hycar OR-25 EP, and easy-processing, nonstaining type, Hycar OR-25 NS. May be compounded in colors.

Type PA (heat-resistant): Elastomeric polymer of acrylic acid ester; responsive to a unique vulcanization process which converts these chemically saturated thermoplastic materials to thermoset or "cured" products. May be compounded on conventional rubber processing equipment, using compounding ingredients and a technique similar, in general, to that employed for crude and other American rubber. Vulcanized products exhibit outstanding resistance to heat, ultraviolet light, ozone, gas diffusion and flexural breakdown.

Type OS-10 (oil soluble): Vulcanizable American rubber; butadiene-styrene copolymer. Sheets for molding, extruding and calendering. Flexibility, high; ts, 2000-3000 psi; moisture absorp, low; takes color. For abrasive wheels, electrical insulation and general replacement for natural rubber.

All types used for gaskets, tubing, vibration insulators, packings, hose, printing rolls and blankets, wire covering and jacketing, and any other general type of application where resilient materials are required. All can be compounded into bonehard (Ebonars) with a 100 F higher softening point than obtainable with natural hard rubber.

HYDROCAL (Gypsum cements)—United States Gypsum Co., Chicago 6.

Pattern Shop Hydrocal: Moderately low setting expansion; dimensional accuracy; plastic, free forming and particularly suited for pattern and model making. A general-purpose gypsum cement which can be carved or otherwise worked freely.

A-11: High strength gypsum cement with an exceptionally low setting expansion. Has a short period of plasticity and stiffens rapidly. This makes it difficult to form under a template.

B-11: Low setting expansion, high degree of plasticity, gradual setting action, and is specifically designed for use in the production of built-up models or template-formed models. It is harder to carve than Pattern Shop Hydrocal.

High-Expansion Hydrocal: Moderately strong gypsum cement characterized by a setting expansion approx. 30 times as great as other gypsum cements. Designed to permit the progressive, uniform and accurate expansion of patterns or models to compensate for metal shrinkages. Setting time is similar to Pattern Shop Hydrocal; material is suitable for pouring only.

HYDROSTONE (Gypsum cement)—United States Gypsum Co., Chicago 6.

Extremely hard and strong; cannot be worked under a template; used where extreme surface hardness is required; expansion is greater than Grade A-11 or B-11 Hydrocal.

HYFLEX (Rubber-like plastics tubing)—Irvington Varnish & Insulator Co., Irvington, N.J.

Excellent abrasion resistance; does not become brittle at temperatures as low as —58 F. in six opaque colors; dielectric str, 1000 (volts per mil inst), (dry), 800 (volts per mil inst), (wet), for tubing of wall thicknesses approximately 0.020 in.; ts, 3000 psi; good chemical stability. For moderately low-temperature applications, wire insulation, conduit, lug insulation, low-pressure hose.

HYSOL 6000 (Thermosetting plastic)—Houghton Laboratories Inc., New York.

Rod, tube, sheet, and special sizes. Properties: Sp gr, 1.11-1.18; coef thermal exp'n, 25-60.4 x 10^6; max cont serv temp, 230-250 F; water absorp, 0.10% in 24 hrs; Rock hdns, M 76-85; ts, 11,370 psi; flex str, 15,-540 psi; mod elast, 426 x 10^6; imp str (notched Izod), 1.75 ft-lb; compr str, 14,100 psi; dielectric str, 350 (volts per mil inst); arc resistance, 135 sec; machines as brass, copper and aluminum; odorless, tasteless, nontoxic. For gears, punched press parts, machined pieces, chemical piping and fittings.

HYTEMCO (High alloy nickel iron)—Driver-Harris Co., Harrison, N. J.

Alloy of nickel and iron characterized chiefly by its high-temperature coefficient of electrical resistance. Lends itself advantageously to uses requiring self regulation by temperature such as immersion heaters.

HY-TEMP (Composition)—Keasbey & Mattison Co., Ambler, Pa.

Combination of diatomaceous silica and asbestos fiber made into heat-insulating blocks, cements and pipe covering; high heat resistance; incombustible; and low thermal conductivity. Used for thermal insulation up to 1900 F.

HY-TEN (Alloy steel) — Wheelock, Lovejoy & Co. Inc., Cambridge 39, Mass.

A-1X: C 0.20, high Mn-Mo alloy steel. Rough bars or billets, finished rods or bars and forgings. For machining and hot working. Heat treated: Ts, 110,000 psi; ys, 65,000 psi; elong in 2 in., 25%; impact str (Izod), 85 ft lb; weldability, fair; abrasion resistance, high. For gears, bushings, cams, clutches, bolts, etc.

B-2: C 0.40, Mn-Cr alloy steel. Rough bars or billets, finished rods or bars and forgings. For machining and hot working. Properties, untreated: Ts, 100,000 psi; ys, 60,000 psi; elong in 2 in., 26%; bhn, 187; weldability, fair. For shafts, gears, spindles, screws, studs, racks, etc.

B-3X: C 0.50, Mn-Cr-Mo alloy steel. Rough bars or billets, finished rods or bars, and forgings. For machining and hot forging. Properties, heat-treated: Ts, 181,000 psi; ys, 164,000 psi; elong in 2 in., 14%; impact str (notched Izod), 30 ft-lb; bhn, 388; weldability, fair; max cont serv temp, 900 F. For gears, axles, spindles, clutches, etc.

B Temper No. 5: C 0.95, electric furnace steel. Rough bars or billets, finished rods or bars and forgings. For machining and hot working. Properties, heat-treated: Rock hdns, C65; abrasion resistance, high; machinability, good. For cold heading dies, rolls, bushings, gages, cams, etc.

M Temper: C 0.70, Cr-Ni-Mo alloy steel. Rough bars or billets, finished rods or bars and forgings. For machining and hot working. Properties, heat-treated: Ts, 294,000 psi; ys, 240,000 psi; elong in 2 in., 5½%; impact str (notched Izod), 5 ft-lb; Rock hdns, C60. For rolls, cams, clutches, collets, gears, gages, etc.

HYTENAT (Aluminum castings)—B & S Bronze Foundry, Inc., Brooklyn 2, N. Y.

Aluminum castings requiring no heat treatment. Ts, 35,000 psi; ys, 25,000 psi; elong in 2 in., 4-5%; bhn, 74.

HY-TEN-SL (Aluminum manganese bronzes)—American Manganese Bronze Co., Philadelphia 36, Pa.

Available in five grades as rough bars or billets, finished rods or bars, castings and forgings, as follows:

No. 1: Cu 60-68, Zn 20-24, Al 3-7, Mn 2.5-5 and Fe 2-4. Properties, untreated: Ts, 108,000 psi min; comp ys, 58,000 psi min; ys, 65,000 psi; elong in 2 in., 14%; imp resistance, medium; bhn, 220; practically nonmagnetic; weldability, fair; max cont serv temp, 500 F; abrasion resistance, medium; pressure resistance, good. Used for lifting nuts, housing nuts, worm wheels (slow speed), spur and bevel gears, etc.

No. 1A: Cu 60-68, Zn 20-24, Al 3-7, Mn 2.5-5 and Fe 2-4. Properties, untreated: Ts, 115,000 psi min; comp ys, 65,000 psi min; ys, 75,000 min; elong in 2 in., 12%; imp resistance, medium; bhn, 240 min; practically nonmagnetic; weldability, fair; resists corrosion caused by water, air, etc.; max cont serv temp, 500 F; abrasion resistance, medium. For same applications as No. 1.

No. 2 (sand cast): Ts, 100,000 psi; ys, 55,000 psi; elong in 2 in., 15%; comp ys, 50,000 psi.

No. 3: Cu 60-68, Zn 20-24, Al 3-7, Mn 2.5-5 and Fe 2-4. Properties, untreated: Ts, 90,000 psi min; comp ys, 40,000 psi min; ys, 45,000 psi min; elong in 2 in., 20% min; imp resistance, medium; bhn, 175; practically nonmagnetic; weldability, fair; resists corrosion caused by air, water, etc; max cont serv temp, 500 F; abrasion resistance, medium; good pressure resistance. For applications same as Nos. 1 and 1A.

No. 4 (sand cast): Ts, 85,000 psi; ys, 40,000 psi; elong in 2 in., 25%; comp ys, 35,000 psi.

Also producers of manganese-bronze sand and centrifugal castings, hot-rolled and extruded rods, bars, shapes and sheets and forgings; gun metal sand and centrifugal castings; phosphor bronze sand castings; red brass sand and centrifugal castings; valve bronze sand castings; nickel-bronze and cupronickel castings; silicon bronze sand, centrifugal and permanent-mold castings, forgings, rods, bars, sheets, tubing and extruded sections; and bearing bronzes.

HY-TUF (Low alloy steel)—Crucible Steel Co. of America, New York.

C 0.25, Mn 1.30, Si 1.50, Ni 1.80, Mo 0.40. Properties (400 F temper): Ts, 239,000 psi; yp, 183,000 psi; elong in 2 in., 14%; reduction in area, 47%; imp str (Izod), 33 ft-lb; machinability, similar to standard low alloy steels; weldability, good. For aircraft and automotive parts, gears, power plant equipment, etc.

IDEAL ELECTRIC STEEL (Carbon, alloy and die steels)—The National Supply Co., Torrance, Calif.

Sand castings and open die forgings of carbon and alloy steels produced to standard or special specifications, SAE, AISI, ASTM, etc.

IDEALOY (Bearing alloy)—Wellman Bronze & Aluminum Co., Cleveland.

Copper-tin-zinc for heavy-duty bearings.

ILLINOIS (Sheet and strip zinc)—Illinois Zinc Co., Chicago 32.

Straight and coiled strip and in sheet and plate, for stamping and drawing. Properties, untreated: Ts, 25,000 psi; weldability, poor; ductility, high. For nameplate and instruction plates, transformer cases, etc.

ILLIUM G (Cast nickel alloy)—Burgess-Parr Co., Freeport, Ill.

Ni 54-58, Cr 20-24, Cu 5-7, Mo 5-7, Mn 0.75-1.5, Si 0.65 max, C 0.2 max. Sand permanent-mold, and precision castings to specification. Other methods of fabrication include machining and arc, gas and resistance welding. No heat treatment required. Ts, 60-73,000 psi; elong in 2 in., 4 to 9.5%; impact (Charpy), 40.3-52.1 ft-lb at room temperature; bhn, 160-210; sp gr, 8.31; nonmagnetic, weldability, good; max cont serv temp, 1900 F; abrasion resistance, medium to good. Resists most corrosive solutions in a wide range of temperatures and concentrations including the halogens in dry state and their salts and acids in low concentrations at ordinary tempera-

tures. For pumps, meters, chemical equipment and other parts subject to corrosion.

INCELOID (Plastic adhesives)—American Products Mfg. Co., New Orleans.

Plastic adhesives for bonding all types of surfaces except when both surfaces are nonporous. Water-proof, vermin and rodent resistant, flame retardant and has indefinite longevity. Excellent chemical resistance to alkalies, acids and many solvents; max cont serv temp, 180 F; nonflammable; flexibility, good; dielectric str, 800 (volts per mil inst); ts, 13,500 psi; moisture absorp, low; all colors; sp gr (dry), 1.52; available transparent, translucent or opaque.

INCELOID (Thermoplastic plastics)—American Products Mfg. Co., New Orleans.

Cellulose derivative sheets for extruding. Abrasion resistance, medium; resistant to mild acids and alkalies, water, and hydrocarbons; max cont serv temp, 180 F; dielectric str, about 800 volts per mil; ts, 9000 psi; comp str, 11,000 psi; in color; moisture absorp, medium; sp gr, 1.27; translucent and transparent; machinability good. For heat and electrical insulating covering.

INCONEL (High-Ni-Cr-Fe alloy)—International Nickel Co. Inc., New York.

Wrought and cast forms. Ni 77.0, Cu 0.2, Fe 7.0, Mn 0.25, Si 0.25, C 0.06, Cr 15.0. Nonmagnetic. Wrought form: Rod and bar, cold-drawn wire, hot-rolled plate, cold-rolled sheet and strip, cold-drawn tubing. Properties of wrought forms (ranges for various forms and tempers): Ts, 80-185,000 psi; ys, 25-175,000 psi; elong in 2-in., 50-2%; bhn, 120-350. Good corrosion resistance; good hot and cold workability. Good high-temperature properties. For airplane-engine exhaust manifolds, springs that must operate at high temperatures, and in the food and chemical industries for heaters, stills, condensers, tanks, piping, valves, etc. In photographic field for pumps, reels, shafts, heat treating fixtures, mufflers, carburizing boxes, etc.

Inconel Castings: Ni 77.5, Cu 0.25, Fe 6.0, Mn 0.8, Si 2.0, C 0.20, Cr 14.0. Sand, centrifugal, precision-investment castings. Properties, untreated: Ts, 70-95,000 psi; ys, 30-45,000 psi; elong in 2 in., 30-10%; bhn, 160-190; nonmagnetic; weldability, fair; abrasion resistance, medium; good high-temperature properties; good corrosion resistance. For parts which need high corrosion resistance and/or resistance to elevated temperatures.

Inconel X: High nickel alloy Ni 73, Cr 15, Fe 7, Ti 2.5, Cb-1, Al 0.9, Si 0.4, Mn 0.5, C 0.05. Rough bars or billets, finished rods or bars, straight and coiled strip, tubing, precision castings, wire, sheet and plate. Properties, unheat-treated: Ts, 110-130,000 psi; ys, 50-65,000 psi; elong in 2 in., 45-35%; bhn, 180-300. Properties, heat-treated: Ts, 155-200 psi; ys, 120-140,000 psi; elong in 2 in., 25-20%; imp str (Charpy, B notch), 38 ft-lb; endurance limit, 65,000 psi; bhn, 315-400. Properties, cold-worked heat-treated: Ts, 250-300,000 psi; ys, 200-250,000 psi, elong in 2 in., 10-2%; bhn, 500-550. Sp gr, 8.3; nonmagnetic to minus 280 F; machinability, fair; weldability, good; resists corrosion caused by many acids and oxidizing gases at elevated temperatures; max cont serv temp, 1500 F; abrasion resistance, medium. Low creep rate at 1200-1500 F. For gas turbines, springs at temperatures up to 1000 F.

INDIUM (Lead-silver solder)—Indium Corp. of America, New York.

A very soft metal used electrolytically or as a constituent of nonferrous alloys. Commercial grade 99.9+ per cent pure. Finished rods, bars, foil or powder. Sp gr, 7.31; resists corrosion caused by salt spray and acids in oil; abrasion resistance, high. Used for bearing surfaces, protective coating for moving parts subject to wear and corrosion, etc.

INDUR (Phenolic-base plastics)—Reilly Tar & Chemical Corp., Indianapolis.

Thermosetting: Powder form, for molding into parts. Ts, 8560 psi; dielectric strength, high; nonflammable; moisture absorp. low; heat resistance, high, corrosion and abrasion-resistant; in colors; flexibility, medium; sp gr, 1.37+. Used for instruments and machine accessories including insulating panels, knobs and handles, control levers, gears, etc.

INDUR VARNISH — Reilly Tar & Chemical Corp., Indianapolis.

Phenolic base, thermosetting: For molding into parts. Dielectric str and ts, high; nonflammable; transparent; corrosion and heat-resistant; impact-resistant; moisture absorp, low. For laminated gears.

INGACLAD (Stainless-clad steel) — Ingersoll Steel & Disc Div., Borg-Warner Corp., Chicago.

Consists of a layer of 18-8 Cr-Ni, Type 304, also 18-8 Cb stabilized and 18-8 Mo bearing, stainless layer bonded to a layer of ordinary steel. Uses include equipment for chemical, food, dairy, processing, brewery, packing house, bottling industries, etc.; suitable for applications requiring stainless steel protection on one surface.

INGERSOLL (Stainless steels)—Ingersoll Steel & Disc Div., Borg-Warner Corp., Chicago.

Sheet and plate. For data on types, properties, characteristics and applications see "Stainless Steels" listing at end of this section.

INLAND (Steels)—Inland Steel Co., Chicago 3.

All AISI and SAE carbon steels; also carbon steels to ASTM and ARA mechanical property specifications, and Cr-Mn and Si-Mn alloy spring steels. Also any carbon steel to special chemical or mechanical requirements conforming to the limits set up as acceptable by the AISI.

INSULKOTE (Weatherproof coating) — Johns Manville, New York 16.

Weatherproof, heat-resistant coating for use over insulation of ducts and other exposed equipment.

INSUROK (Plastics)—The Richardson Co., Melrose Park, Ill.

Thermosetting type: Laminated sheets, rods and tubes for machining or punching into parts, or as finished fabricated or molded parts. Excellent electrical characteristics; corrosion-resistant; moisture absorp, low; high tensile strength; resistant to shock; comparatively low specific gravity. For gears, bearings, electrical insulation. Available in different grades.

Thermoplastic type: Molded parts. Dielectric str, high; moisture absorp, low; high tensile strength; low specific gravity. Available in color.

Translucent type: Urea, melamine or phenolic base; thermosetting. Laminated sheets and fabricated parts, for instrument dials, etc. Translucent.

INTERNATIONAL (Graphite) — International Graphite & Electrode Corp., St. Marys, Pa.

Graphite electrodes for electric furnaces, graphite anodes for electrolytic cells, graphite molds for casting alloys, pressure sintering and centrifugal casting.

INTRA (Tool steel) — H. Boker & Co., Inc., N. Y. C.

Water-hardening tungsten alloy steel. For taps, woodworking tools, mandrels, etc.

INTUC (Plastics laminate)—Insulating Tube Co. Inc., Poughkeepsie, N. Y.

Thermosetting phenol formaldehyde laminate in tube form. Ts, 8265 psi; dielectric str, 720 (volts per mil short-time); in natural tan and black; moisture absorp, low; machinability, good.

IRALITE (Alloy cast iron)—Mackintosh-Hemphill Co., Pittsburgh.

C 2.8-3.5, plain and alloyed cast iron. Ni, Mo and Cr as required. Castings. Ts, 40-75,000 psi; bhn, 175-400; magnetic; resists corrosion caused by acids; heat-resistant to 1500 F; abrasion resistance, high. For lathe and engine beds, etc.

IRILITE (Sheet plastic)—The Richelieu Corp. New York.

Methyl methacrylate or vinyl chloride acetate thermoplastic plastic. In many colors; moisture absorp, low; opaque; machinability, good. These sheets are impregnated with iridescent particles for use in toilet-ware displays, optical frames, musical instruments, etc.

IRVINGTON (Insulating varnishes) — Irvington Varnish & Insulator Co., Irvington, N. J.

Synthetic, internal-drying, clear and black insulating, oleo-resinous type varnishes; air-drying varnishes; clear or black oilproof finishing varnishes, sticking varnishes, red, oilproof enamels; gray or black machinery enamels. Wide selection to meet ordinary and special requirements.

IRVINGTON (Varnished fabrics) — Irvington Varnish & Insulator Co., Irvington, N. J.

Varnished cambric, canvas, cotton duck, Fiberglas, silk, Nylon, rayon, Silicone varnished Fiberglas, varnished papers; ranging from thin condenser tissues to heavy fibrous types.

Plastic marker insulators. Extruded plastic tubing sleeves, marked to specification; serve both as wire markers and lug insulators; high dielectric strength; resistant to heat, acids, alkalies, oil and many solvents; do not support combustion. Obtainable in numerous color combinations, and in standard tubing sizes.

Transformer lead tubing to specification. Several layers of varnished cambric over which saturated braid has been drawn; assembly is dipped in varnish and thoroughly baked.

Varnished markers. Short lengths of varnished tubing marked to specification. Used to identify leads; inside-and-out coatings resist oil, gasoline, washing down of motors, high engine temperature.

IRV-O-LITE XTE 30 (Thermoplastic plastics)—Irvington Varnish & Insulator Co., Irvington, N. J.

Rods, tubes and for extruding. Abrasion resistance, high; chemical resistance, good; max cont serv temp, 167 F; flexibility, high; dielectric str, 1000 (volts per mil inst); moisture absorp, low; in black, green, white, yellow, red and blue; sp gr, 1.293; opaque. For wire insulation, conduit, lug insulations, etc.

IRV-O-SLOT (Insulation)—Irvington Varnish & Insulator Co., Irvington, N. J.

Stator or armature slot insulation. Consists of varnished fabrics duplexed to fish or 100% rag papers; flexible binding adhesive prevents separation during shaping and forming, contributes to insulating qualities. Obtainable in a wide variety of combinations and thicknesses in the form of sheets, tape and punchings.

IRV-O-VOLT (Flexible varnish tubing and sleeving)—Irvington Varnish & Insulator Co., Irvington, N. J.

Flexible varnished inside-and-outside tubing in six colors. Braided cotton, rayon, Fiberglas tubular sleeving, treated with oleo-resinous varnishes.

Types A-A-1, A-B-1, A-C-1, A-C-2: Conform to ASTM and NEMA specifications for similarly designated grades; inside varnish coating yields a smoother inside wall, speeding assemblies; greatly retards moisture absorp; eliminates feathering action of ordinary braid and wicking action when used in oil-filled transformers; provides margin of insulation protection should outside coating become chafed.

ISOCAST (Steel castings)—Empire Steel Castings, Inc., Reading, Pa.

M: C 0.10-0.20, Mn 0.50-0.70, Si 0.35-0.45. Ts, 55-65,000 psi; ys, 30-35,000 psi; elong, 22-35%; bhn, 120. For motor and instrument parts.

1: C 0.20-0.30, Mn 0.50-0.70, Si 0.35-0.45. Ts, 65-75,000 psi; ys, 35-45,000 psi; elong, 20-30%; bhn, 130. General-purpose alloy.

1A: C 0.30-0.40, Mn 0.50-0.70, Si 0.35-0.45. Ts, 75-85,000 psi; ys, 45-55,000 psi; elong, 20-25%; bhn, 165. General purpose casting alloy.

1B: C 0.40-0.50, Mn 0.50-0.70, Si 0.35-0.45. Ts 85-95,000 psi; ys, 55-60,000 psi; elong, 15-20%; bhn, 179. General-purpose casting alloy.

2: C 0.50-0.60, Mn 0.50-0.70, Si 0.35-0.45. Ts, 95-105,000 psi; ys, 60-65,000 psi; elong, 10-15%; bhn, 202. General-purpose casting alloy.

2A: C 0.60-0.70, Mn 0.50-0.70, Si 0.35-0.45. Ts, 105-112,000 psi; ys, 65-75,000 psi; elong, 8-12%; bhn, 223. General-purpose alloy.

2B: C 0.70-0.80, Mn 0.50-0.70, Si 0.35-0.45. Ts, 112-118,000 psi; ys, 75-82,000 psi; elong, 5-10%; bhn, 235. General-purpose alloy.

3: C 0.25-0.35, Mn 1.25-1.50, Si 0.35-0.45. Ts, 85-95,000 psi; ys 50-60,000 psi; elong, 18-25%; bhn, 179. For machine and railroad parts.

4: C 0.15-0.25, Mn 0.50-0.70, Si 0.35-0.45, Mo 0.45-0.60. Ts, 65-75,000 psi; ys, 35-45,000 psi; elong, 22-30% bhn, 135. For valves, pumps, fittings.

5: C 0.25-0.35, Mn 1.00-1.25, Si 0.35-0.45, Mo 0.25-0.35. Ts, 70-80,000 psi; ys, 45-55,000 psi; elong, 24-32% bhn, 149. For cams, gears, etc.

6: C 0.25-0.35, Mn 0.50-0.70, Si 0.35-0.45, Ni 1.75-2.25. Ts, 80-95,000 psi; ys, 50-60,000 psi; elong. 22-28%; bhn, 179. For railroad process equipment.

6A: C 0.15-0.25, Mn 0.50-0.80, Si 0.35-0.45, Ni 2.75-3.50. Ts, 75-85,000 psi; ys, 45-55,000 psi; elong. 20-24%; bhn, 159.

7: C 0.25-0.35, Mn 0.50-0.70, Si 0.35-0.45, Cr 1.00-1.50, Ts, 150-175,000 psi; ys, 110-130,000 psi; elong, 15-25%; bhn, 179. For gears, cams, etc.

7A: C 0.80-0.90, Mn 0.50-0.70, Si 0.35-0.45, Cr 1.00-1.50. Ts, 150-175,000 psi; ys, 110-130,000 psi; elong, 0.3%; bhn, 341. For cement mill liners, etc.

8: C 0.25-0.35, Mn 0.60-0.80, Si 0.35-0.45, Cr 1.00-1.25, Mo 0.25-0.35. Ts, 90-105,000 psi; ys, 55-65,000 psi; elong, 15-25%; bhn, 202.

85: C 0.15-0.20, Mn 0.50-0.70, Si 0.35-0.45, Cr 4.00-6.50, Mo 0.40-0.65. Ts, 90-105,000 psi; ys, 60-70,000 psi; elong, 18-24%; bhn, 192.

9: C 0.25-0.35, Mn 0.50-0.70, Si 0.35-0.45, Cr

0.65-0.95, Ni 1.75-2.25, Mo 0.25-0.35. Ts, 95-105,000 psi; ys, 60-75,000 psi; elong, 15-25%; bhn, 202.

9A: C 0.25-0.35, Mn 0.50-0.70, Si 0.35-0.45, Cr 1.0-1.25, Ni 2.25-2.75, Mo 0.30-0.40. Ts 110-125,000 psi; ys, 70-80,000 psi; elong, 15-20%; bhn, 235. For pumps, etc.

WC3: C 0.30 max, Mn 0.70 max, Si 0.60 max, Cr 0.50-0.80, Mo 0.40-0.60. Ts, 70,000 psi; ys, 45,000 psi; elong, 22%; bhn, 163. For valves.

WC5: C 0.25 max, Mn 0.70 max, Si 0.60 max, Cr 0.55-0.85. Ni 0.65-0.95, Mo 0.85-1.05. Ts, 85,000 psi; ys, 55,000 psi; elong, 20%; bhn, 180. For valves, etc.

WC6: C 0.20 max, Mn 0.70 max, Si 0.60 max, Cr 1.00-1.50, Mo 0.40-0.60. Ts 70,000 psi; ys, 45,000 psi; elong, 22%: bhn, 163. For valves, etc.

CA-15: C 0.15 max, Cr 11.5-14.0, Si 1.0 max. Ts, 95,000 psi; ys, 65,000 psi; elong 20%; bhn, 200. For valve and pump trim, etc.

CA-40: C 0.20-0.40 max, Mn 11.5-14.0, Si 1.0 max. Ts, 110,000 psi; ys, 75,000 psi; elong, 18%; bhn, 220. For valve and pump trim, etc.

CB-30: C 0.30 max, Cr 18.00-22.00, Si 2.0 max. Ts, 90,000 psi; ys, 40,000 psi; bhn, 200. For valve trim process equipment, etc.

CB-75: C 60-75, Cr 16.00-19.00, Si 2.0 max. Ts, 105,000 psi; ys, 75,000 psi; bhn, 240. for valve and pump trim, etc.

CC-50: C 0.50 max, Cr 26.00-30.00, Si 4.0 max. Ts, 60,000 psi; bhn, 190. For pump parts, ore roasting parts, etc.

CE-30: C 0.30 max, Cr 26.00-30.00, Si 8.00-11.00. Ts 90,000 psi; ys, 55,000 psi; elong, 25%; bhn, 200. For mining equipment, etc.

CF-8: C 0.08 max, Cr 18-21, Ni 8-11. Ts, 75,000 psi; ys, 40,000 psi; elong, 45%; bhn, 140. For pumps, valves and chemical and process equipment.

CF-8M: C 0.08 max, Cr 18-21, Ni 9-12, Mo 2.00-3.00. Ts, 80,000 psi; ys, 40,000 psi; elong, 50%; bhn, 156.

CF-8C: C 0.08 max, Cr 18-21, Ni 9-12, other, Cb 8C. 1.00 max. Ts, 80,000 psi; ys, 44,000 psi; elong, 40%; bhn, 156. For process equipment.

CF-12M: C 0.12 max, Cr 18-21, Ni 9-12, Mo 2.00-3.00. Ts, 80,000 psi; ys, 40,000 psi; elong, 45%; bhn, 170. For chemical and process equipment.

CF-20: C 0.20 max, Cr 18-21, Ni 8-11. Ts, 80,000 psi; ys, 40,000 psi; elong, 45%; bhn, 160. For valves, pumps, textile and processing equipment.

CF-16F: C 0.16 max, Cr 18-21, Ni 9-12, others, Se 0,20-0.35, Mo 1.50 max. Ts, 75,000 psi; ys, 35,000 psi; elong, 40%; bhn, 160. For valves, pumps, textile and processing equipment.

CG-12: C 0.12 max, Cr 20-23, Ni 10-13. Ts, 80,000 psi; ys, 40,000 psi; elong, 40%; bhn, 156. For paper, textile and process equipment.

CG-8M: C 0.08 max, Cr 20-23, Ni 10-13, Mo 2.00-3.00. Ts, 75,000 psi; ys, 40,000 psi; elong, 60%; bhn, 130. For paper, textile and process equipment.

CH-20: C 0.20 max, Cr 22-26, Ni 12-15. Ts, 85,000 psi; ys, 50,000 psi; elong, 25%; bhn, 170. For paper, textile and process equipment.

CK-20: C 0.20 max, Cr 23-27, Ni 19-22. Ts, 75,000 psi; ys, 45,000 psi; elong, 20%; bhn, 190. For paper equipment.

20: C 0.07 max, Cr 20, Ni 29, Mo 1.75 min, Cu 3.5 min. Ts, 65,000 psi; ys, 30,000 psi; elong, 35%; bhn, 140. For pumps, valves and chemical equipment.

N: Ni 97. Ts, 50,000 psi; ys, 25,000 psi; elong, 20%; bhn, 100. For caustic soda equipment.

HC: C 0.50 max, Cr 0.26-0.30, Ni 4 max. Ts, 60,000 psi; bhn, 200. For ore roasting equipment.

HE: C 0.20-0.50, Cr 0.26-0.30, Ni 8-11. Ts, 90,000 psi; ys, 55,000 psi; elong, 20% bhn, 200. For ore roasting and oil still parts.

HH: C 0.20-0.50, Cr 24-28, Ni 11-14. Ts, 85,000 psi; ys, 50,000 psi; elong, 35%; bhn, 170. For furnace parts and tube supports.

HK: C 0.20-0.60, Cr 24-28, Ni 18-22. Ts, 80,000 psi; ys, 45,000 psi; elong, 25%; bhn, 190. For furnace parts and fixture pots.

HT: C 0.35-0.75, Cr 13-17, Ni 33-37. Ts, 75,000 psi; elong, 7%; bhn, 180. For furnace parts and fixture pots.

HW: C 0.35-0.75, Cr 10-14, Ni 58-62. Ts, 65,000 psi; bhn, 190. For furnace parts and fixture pots.

ISOLANTITE (Ceramic)—Isolantite Mfg. Corp., Stirling, N. J.

Strips, rods and tubes and plates. Fabricated into parts by molding, casting, extruding, pressing and machining. Abrasion resistance, high; chemical resistance, high to all chemicals except HF; max cont serv temp, 1800 F; nonflammable; flexibility, low; dielectric str, 250 (volts per mil inst); ts, 8000 psi; compr str, 120,000 psi; flex str, 20,000 psi; elong, nil; moisture absorp, low; in white, brown and various other colors; sp gr, 2.6; opaque; machinability, poor. Primarily used for its insulation and corrosive properties.

IVI-FLEX (Flexible plastics tubing)—Irvington Varnish & Insulator Co., Irvington, N. J.

Extruded plastics tubing, developed for use at extremely low temperatures. Ts, 1000 psi; elongation at break, 400%.

JALCASE (Steels) — Jones & Laughlin Steel Corp., Pittsburgh 30.

Low-carbon open-hearth steel which offers good machinability plus the added advantage of rapid case-carburizing properties. Manufactured as AISI C-1116, C-1117, C-1118 and C-1119 (SAE 1116, 1117, 1118 and 1119), carbon 0.14-0.20.

Open-hearth steel which in the higher carbon range offers exceptional heat treating qualities combined with forging properties and good machinability. Manufactured as AISI C-1132 (SAE 1132), carbon 0.27-0.34; AISI C-1137 (SAE 1137) carbon 0.32-0.39; AISI C-1141 (SAE 1141), carbon 0.37-0.45; C-1144 (SAE 1144), carbon 0.40-0.48.

JALLOY (Special alloy steel)—Jones & Laughlin Steel Corp., Pittsburgh 30.

For applications where heavy impact and dynamic stresses are required; also when heat-treated will give optimum results in resistance to wear or abrasion. For parts such as pins and links on earth-moving, agricultural, mining and oil-well equipment.

JAMESTOWN (Plywood)—Jamestown Veneer & Plywood Corp., Jamestown, N. Y.

Hot-pressed resin-bonded plywood, thermosetting. Sheets for machining. Abrasion resistance, low; resists deterioration caused by moisture; max cont serv temp, 400 F; flexibility, low and medium; approx ts, 2000 psi; comp str, 250 psi; produced in natural wood; largely shatterproof; sp gr, 0.45-0.60; machinability, good.

JEFALOY A Series (Processed iron castings)—Jeffrey Mfg. Co., The, Columbus 16, O.

Properties, unheat-treated: Ts, 35-50,000 psi; compr str, 126-170,000 psi; bhn, 192-248; machinability, good. For pump parts, gears, sprockets, frames, housings, etc.

JEFFREY 55M (Alloy iron castings) — Jeffrey Mfg. Co., The, Columbus 16, O.

Properties, unheat-treated: Ts, 50-60,000 psi; compr str, 171-174,000 psi; bhn, 248-269; abrasion resistance, high. For wear resistant, high-strength parts.

JESSOP (Stainless steels) — Jessop Steel Co., Washington, Pa.

For data on types, properties, characteristics and applications see "Stainless Steels" listing at end of this section.

JEWELL Alloys (Ni-Cr pearlite malleable) — Kencroft Malleable Co. Inc., Buffalo 7.

Si 1.0, C 1.9, Cr 0.35, Ni 1.0. Sand castings. Thoroughly heat-treated before shipment and requires no further heat treatment for physicals shown. Ts, 90,000 psi; ys, 60,000 psi; elong in 2 in., 8%; bhn, 200; weldability, fair; resists corrosion caused by heat, mild acids and alkalies; max cont serv temp, 1200-1300 F; abrasion resistance, high; polishes like nickel plate by ordinary buffing. For industrial uses.

No. 42: Si 1.0, C 1.9, Cr 0.20, Ni 0.50. Sand castings. Thoroughly heat treated before shipment and requires no further heat treatment for physicals shown. Ts, 70,000 psi; ys, 50,000 psi; elong in 2 in., 15%; bhn, 250; weldability, fair; resists corrosion caused by heat, mild acids and alkalies; max cont serv temp, 1100 F. Recommended as a free-machining material with high yield point and enough ductility to stand shock and abuse. For all industrial uses.

"V": Si 1.0, C 1.9, Cr 0.35, Ni 0.50. Sand castings. Thoroughly heat treated before shipment and requires no further treatment for physicals shown. Ts, 85,000 psi; ys, 70,000 psi; elong in 2 in., 5%; bhn, 250; weldability, fair; resists corrosion caused by heat, mild acids and alkalies; max cont serv temp, 1000-1100 F; abrasion resistance, high; especially recommended for compressor valves and wherever battering of two metals is encountered. For all industrial uses.

Super-strength malleable: Ts, 57,000; ys, 38,000; elong in 2 in., 18%; bhn, 120.

J & L Steels (Cold-finished steels) — Jones & Laughlin Steel Corp., Pittsburgh 30.

Cold finished steel in bars, shapes, rounds, flats, hexagons and special shapes. Easily machined. For gears, tubing, piston pins, generator parts and shafts, steering wheel hubs, etc. Also special cold-drawn shapes and Electricweld mechanical tubing.

J-M ASBESTOS EBONY (Asbestos sheet) — Johns-Manville, New York 16.

Asbestos fibre and cement impregnated with insulating compound. Sheet material for switchboard panels, controller plates, switch bases, bus-bar supports and other electrical mountings. Available from ⅛ to 4 in. thick.

J-M QUINORGO (Asbestos electrical insulation)—Johns Manville, New York 16.

Asbestos fibre and 15% organic binders. Heat resistant electrical insulation in tape, sheet or roll in thicknesses from 5 mils. Retains dielectric strength to 130 C (Class B insulation). For layer and wrapper insulation for coils and for wire insulations in transformers and motors. Also employed in making composite insulations.

J-M QUINTERRA (Asbestos electrical insulation)—Johns-Manville, New York 16.

Inorganic base sheet of purified asbestos fibre treated with resin for mechanical strength. Heat resistant electrical insulation as tape, sheet, or roll in thicknesses from 3 mils. Dielectric strength unaffected after 168 hours at 200C. For layer and wrap insulation for coils and for wire insulations in transformers and motors.

J-M TRANCELL (Asbestos sheet)—Johns-Manville, New York 16.

Asbestos fibre and inorganic binder. Sheet material for cell structures, barriers and partitions used for housing and protecting electrical equipment. Full size sheets can be shop fabricated easily since no special tools are required. Cut panels furnished to customer specifications. Construction entirely dry. Available in several sizes and thicknesses.

J-M TRANSITE (Asbestos-cement)—Johns-Manville, New York 16.

Asbestos-cement. Flat or corrugated sheets for construction or fabrication. Pipe form for conducting water and process liquids and as industrial vent pipe for handling corrosive vapors.

JOBBINS (Aluminum casting alloys)—William F. Jobbins, Inc., Aurora, Ill.

Almag 35: Mg 6.0-8.5, Al balance. Sand castings, permanent-mold castings, die castings. Properties, as sand-cast: Ts, 40,000 psi; ys, 20,000 psi; elong in 2 in., 12.0%; bhn, 70. Properties, as permanent-mold cast: Ts, 42,000 psi; ys, 23,000; elong in 2 in., 10.0%; bhn, 75. Properties, as die-cast: Ts, 47,000 psi; ys, 29,500 psi; elong in 2 in., 7.5%. Machinability in all forms, excellent; corrosion resistance in all forms, excellent. For parts requiring highest mechanical and shock resistance properties without heat treatment or aging.

3-6 Supreme: Cu 2.75-3.75, Si 5.5-6.5, Al balance. Properties, as sand-cast: Ts, 29,000 psi; ys, 17,000 psi; elong in 2 in., 2.5%; bhn, 75. Properties of sand castings after T-6 solution heat treatment: Ts, 40,000 psi; ys, 28,000 psi; elong in 2 in., 2%; bhn, 90. As-cast properties of permanent-mold castings: Ts, 31,000 psi; ys, 18,000 psi; elong in 2 in., 3.0%; bhn, 75. Properties of permanent-mold castings after T-6 solution heat treatment: Ts, 44,000 psi; ys, 30,000 psi; elong in 2 in., 2.5%; bhn, 95. Contains special elements to minimize shrinkage and hot-shortness and to refine grain.

4-8 Supreme: Cu 3.5-4.5, Si 7.5-9.5, Al balance. Permanent-mold castings only. Properties, as cast: Ts, 32,000 psi; ys, 17,000 psi; elong in 2 in., 2.5%; bhn, 85. Properties after T-6 solution heat treatment: Ts, 45,000 psi; ys, 28,000 psi; elong in 2 in., 3.0%; bhn, 100. For intricate castings requiring high mechanical properties and pressure tightness.

3-6-6 Supreme: Cu 2.5-3.5, Si 5.0-6.0, Zn 5.0-6.0, Al balance. Sand castings and permanent-mold castings. Properties of sand castings, as cast: Ts, 26,000 psi; ys, 14,500 psi; elong in 2 in., 2.0%; bhn, 65. Properties of sand castings after T-6 solution heat treatment: Ts, 45,000 psi; ys, 38,000 psi; elong in 2 in., 1.0%; bhn, 100. Properties of permanent-mold castings, as cast: Ts, 30,000 psi; ys, 14,500 psi; elong in 2 in., 3.0%; bhn, 70. Properties of permanent-mold castings after T-6 solution heat treatment: Ts, 46,000 psi; ys, 40,000 psi; elong in 2 in., 1.5%; bhn, 100. Unusual castability; minor elements controlled to give lowest shrinkage and hot-shortness and prevent sticking in permanent molds. For the most intricate castings, requiring pressure tightness and high mechanical properties.

Almag 56: Mg 9.5-10.5, Al balance. Properties of sand castings after T-4 solution heat

treatment: Ts, 58,000 psi; ys, 30,000 psi; elong in 2 in., 18.0%; bhn, 95; endurance limit, 20,000 psi; imp str (Charpy), 9½ ft-lb; machinability, excellent; corrosion resistance, excellent. For cast parts requiring highest obtainable strength, ductility, endurance limit and shock resistance for aluminum castings.

JODA (Thermoplastic plastics) — Joseph Davis Plastics Co., Arlington, N. J.

Sheet, strip, rods or tubes, plates and film. Abrasion resistance, medium; max cont serv temp, 130 F; transparent; all colors; shatterproof; sp gr, 0.9-1.3; machinability, good. Used for dials, lenses, knobs, wheels, etc.

JODAPAC (Thermoplastic plastics)—Joseph Davis Plastics Co., Arlington, N. J.

Polythene or polyethylene thermoplastic plastics: Sheet, rods, tubes, and film. Max cont serv temp, 100 F; dielectric str, (volts per mil inst), 400-600; ts, 17-1900 psi; all colors; moisture absorp, low; sp gr, 0.92; transparent, translucent, and opaque; machinability, fair. Used in electroplating industry, food packaging, etc.

JOHNSON (Bearing metals) — Johnson Bronze Co., New Castle, Pa.

Babbitt furnished in following grades:

No. 10 (SAE 10): Sn 90, Cu 5, Sb 5. Rough bars or billets, for permanent-mold and die casting. Ts, 10-13,000 psi; comp str, 5-7000 psi; bhn, 28-30; sp gr, 7.2; nonmagnetic; resists corrosion caused by organic acids in lubricating oils; max cont serv temp, 200-250 F; abrasion resistance, high. For automotive main and connecting-rod bearings; high-speed, medium-load and precision-assembly bearings, etc.

No. 11 (SAE 11): Sn 87, Sb 7, Cu 6. Rough bars or billets for permanent-mold and die casting. Ts, 10-13,000 psi; comp str, 5-6000 psi; bhn, 28-29; sp gr, 7.2; nonmagnetic; resists corrosion caused by organic acids in lubricating oils; max cont serv temp, 200-250 F. For automotive main and connecting-rod bearings subjected to heavy pressures.

No. LX (SAE 14): Pb 74-75, Sb 15, Sn 10, Cu 0.25. Rough bars or billets, for permanent-mold or die casting. Annealed before machining. Properties, untreated: Ts, 8-12,000 psi; comp str, 5-6000 psi; bhn, 27-29; sp gr, 10.0; nonmagnetic; resists corrosion caused by organic acids in lubricating oils; max cont serv temp, 200-225 F; abrasion resistance, high. For car box journals, crane bearings, woodworking and metalworking machine tools, mining machinery bearings, automotive applications, etc.

Bronze alloys in following grades:

No. 19: Cu 70, Sn 11, Pb 19. Cast to specification, for machining. Properties, untreated: Ts, 22,500-32,500 psi; comp str, 13,000-15,000 psi; ys, 18,000-24,000 psi; elong in 2 in., 14 to 17%; impact str (Izod), 3.4 ft-lb; bhn, 62; sp gr, 8.98; nonmagnetic; resists corrosion caused by atmospheric conditions and fresh water; max cont serv temp 300-400 F; abrasion resistance, high. Used on mill bearings, gas and diesel engine bearings, excavating and pulverizing machinery, etc.

No. 25 (Plastic Bronze): Cu 75, Sn 5, Pb 19, Ni 1. Cast to specification for machining. Properties, untreated state: Ts, 17,500-27,500 psi; comp str, 8-12,000 psi; ys, 13,750-19,750; elong in 2 in., 7 to 15%; impact str (Izod), 5.2 ft-lb; bhn, 44; sp gr, 9.05; nonmagnetic; resists corrosion caused by diluted acids, atmospheric conditions, and fresh water; max cont serv temp, 300-400 F; abrasion resistance, high. For sleeve bearings used in pumps, electric motors, conveyors, fans, woodworking and lapping machines. For high speeds, light loads and no shock.

No. 27 (SAE 64): Cu 80, Sn 10, Pb 10. Deoxidized with phosphorus. Finished rods or bars and cast to specification. Properties, untreated: Ts, 30-40,000 psi; comp str, 13-15,000 psi; ys, 16-22,000 psi; elong in 2 in., 10 to 30%; impact str (Izod), 4.5 ft-lb; bhn, 58; sp gr, 8.75; nonmagnetic; resists corrosion caused by most acids, highly diluted, sea air, atmosphere and fresh water; max cont serv temp, 300-400 F; abrasion resistance, high. For sleeve bearings for most machinery and machine tools, valve and pump parts, general automotive bearings, appliances, etc.

No. 29 (SAE 67): Cu 78, Sn 7, Pb 15. Cast to specification. Properties, untreated: Ts, 10-29,000 psi; comp str, 13-15,000 psi; ys, 13,400-19,400 psi; elong in 2 in., 5 to 13%; impact str (Izod), 5.6 ft-lb; bhn, 52; sp gr, 8.9; nonmagnetic; resists corrosion caused by 20% solution hydrochloric acid, other diluted acids, atmospheric conditions, etc.; max cont serv temp, 300-400 F; abrasion resistance, high. For high-speed sleeve bearing applications with medium loads and soft shafts, acid-resisting bearing applications, fractional horsepower motors, etc.

No. 53 (SAE 62): Cu 88, Sn 10, Zn 2. Cast to specification. Properties, untreated: Ts, 31-41,000 psi; comp str, 13-16,000 psi; ys, 16-22,000 psi; elong in 2 in., 14 to 22%; impact str (Izod), 8.5 ft-lb; bhn, 69; sp gr, 8.5; nonmagnetic; weldability, fair; resists corrosion caused by atmospheric conditions, fresh water, highly diluted acids and sea water; max cont serv temp, 600-900 F; abrasion resistance, high. For gears and gear bushings, piston-pin and valve-guide bushings, steering-sector and hinge bushings, heavy-duty bearings, high-pressure air valves.

No. 72 (SAE 660): Cu 83, Sn 7, Pb 7, Zn 3. Finished rods or bars, cast to specification. Properties, untreated: Ts, 24-34,000 psi; comp str, 12-14,000 psi; ys, 11,600-17,600 psi; elong in 2 in., 12 to 22%; impact str (Izod), 8.6 ft-lb; bhn, 56; sp gr, 8.7; nonmagnetic; resists corrosion caused by atmospheric conditions, fresh water and highly diluted acids; max cont serv temp, 300-400 F; abrasion resistance, high. For general machinery bearing applications.

JOHNSON (Rubber)—Johnson Rubber Co., Middlefield, O.

Molded and extruded rubber in any shape and quantity to specification.

"K" (Felt)—American Felt Co., Glenville, Conn.

Kapok felts to Air Corps Specification 16098, Types I and II. Corrosion-resistant, impact-resistant and nonflammable; for insulating, etc.

K (Flexible plastic)—Sandee Manufacturing Co., Chicago 30.

Rods, tubes and special shapes. Abrasion resistance, high; not affected by alkalies or mineral acids except strong sulfuric acids; dielectric str, 300-400 (volts per mil inst); ts, 1500-3000 psi; all colors; moisture absorp, 0.4-0.65; sp gr, 1.23-1.42; transparent, translucent and opaque. Flexible tubing for oil lines, drain and coolant tubing, electrical insulation and cable covering.

K-42-B (Ni-Co-Cr-Fe alloy)—Westinghouse Electric Corp., East Pittsburgh, Pa.

Ni 42, Co 22, Fe 14, Cr 18, Ti 2.10. Rough bars or billets, rods or bars, wire, strips (coiled), and plates. For hot forging, stamping, turning, boring, welding, etc., also as sand castings. Resists corrosion caused by atmosphere and salt solutions; max cont serv temp 1200 F; ts, 157,000 psi; nonmagnetic; bhn, heat-treated, 280. For applications where high strength at high temperatures is required.

KAISALOY (Steel)—Kaiser Steel Corp., Oakland, Calif.

C 0.15, Mn 0.95, P 0.02, S 0.03, Si 0.02, Cr 0.12, Ni 0.20, Mn 0.05, V 0.04, Ti 0.01, Cu 0.25. Rough bars or billets, finished rods or bars, straight and coiled strip, sheet, plate and structural shapes. Properties, unheat-treated: Ts, 74,950 psi; ys, 55,260 psi; elong in 2 in., 26%; machinability, good; weldability, good; abrasion resistance, very high.

KAISER ALUMINUM (Aluminum alloys)—Kaiser Aluminum & Chemical Corp., Oakland 12, Calif.

Sheet, coil, plate, circles, pig, ingot, foil, electrical conductor, residential siding, corrugated farm and industrial roofing, shade screening, rod, wire, bar, screw machine stock, forging stock, rivet wire, roll-formed shapes.

KARBATE (Impervious carbon and graphite)—National Carbon Div., Union Carbide & Carbon Corp., New York 17.

Corrosion-resistant materials. Impervious to seepage of liquids and gases under pressure. Possesses the following characteristics: Resistance to action of all acids, alkalies and salt solutions except those of a highly oxidizing nature; freedom from corrosion scale formation; resistance to thermal shock; ease of machining. Impervious graphite base products have excellent thermal conductivity. Available in the form of brick, plates, tile, pipe, fittings, valves, pumps, heat exchangers, towers and tower accessories such as bubble caps, trays, distributor plates, etc. Highly resistant to reaction with most materials encountered in chemical manufacturing plants and chemical processes at the concentrations and temperatures ordinarily employed.

KARMA (Low temperature-coefficient-of-resistance, high specific-resistance alloy)—Driver-Harris Co., Harrison, N. J.

High nickel-chromium alloy with a low temperature coefficient of resistance (±.00002 max. from —50 C to 100 C) with a high specific resistance (800 ohms/cmf at 20 C), low thermal emf against Cu, high resistance to oxidation and high tensile strength. Especially adapted for service in small-dimension precision resistors that are subjected to large changes in temperature.

KELCAST (Mold iron)—Kelly Foundry & Machine Co., Elkins, W. Va.

Special alloyed, heat-resistant mold iron cast to patterns for: Blow molds, press molds, blanks, bottom plates, plunger rings, side plates, etc.

KELCAST MM (Alloy cast iron)—Kelly Foundry & Machine Co., Elkins, W. Va.

High graphite cast iron. Solid round bars, bushings, square bars, rectangular bars, discs, plates. Machinability, good; wear good. For gears, cams, valve seats, bearings, surface plates, tools, molds, etc.

KEL-F (Plastic)—Plax Corp., West Hartford, Conn.

Thermoplastic polymer of trifluoro-monochloroethylene in sheet, rods and tubes. Abrasion resistance, medium; resists all solvents, acids and alkalies; max cont serv temp, 400 F; flex str, 8000 psi; ts, 94,000 psi; imp str (Izod), 1.8-3.5 ft-lb; natural clear to milky white color; sp gr, 2.12; moisture absorp, low; transparent in thin sections; translucent in heavy sections; Shore Durometer hardness 78 (D scale); for electrical insulators, gaskets, etc.

KENNAMETAL (Tungsten-titanium carbides and tungsten carbides)—Kennametal, Inc., Latrobe, Pa.

Grade KM: Tungsten-titanium carbide ($WTiC_2$) with other refractory metal carbides and the optimum content of binder. Powder metal, sintered form. Not heat-treatable; trans. str, 300,000 psi; comp str, 600,000 psi; ys, 305,000 psi; mod of elas, 74,000,000 psi; impact str, (Charpy) 8.9 ft-lb, endurance limit, 85,000 psi; Rock hdns, C78; sp gr, 12.00; magnetic permeability, 3.00; resistance to corrosion, excellent at room temp; max cont serv temp, 1200 F; abrasion resistance, high. For pins and rollers, bushings, cam followers, bearings, chuck jaws, spindles, check-valve balls and seats, seaming rolls, etc., where galling is involved.

Grade K3H: Contains higher percentage of tungsten-titanium carbide ($WTiC_2$), and lower content of cobalt, than grade KM, consequently it is not quite as strong, but considerably harder. Trans. str, 250,000 psi; comp str, 585,000 psi; Young's mod of elas, 72,100,000 psi; impact str, (Charpy) 5.3 ft-lb; Rock hdns, C79; sp gr, 11.10; magnetic permeability, 2.00. It resists oxidation and corrosion at high temperature better than other standard grades. Useful for same applications as KM, but has greater resistance to galling.

Grade K6: Primarily composed of tungsten carbide with low content of cobalt binder. Powder metal, sintered forms. Not heat-treatable. Trans str, 250,000 psi; comp str, 800,000 psi; ys, 225,000 psi; mod of elas, 94,300,000 psi; impact str, (Charpy) 9.5 ft-lb; endurance limit, 85,000 psi; Rock hdns C80; sp gr, 15.10; magnetic permeability, 1.5; resistance to corrosion, excellent at room temp; max cont serv temp, 1200 F; abrasion resistance, high. For valve tappets, work rests, dovetail ways, wear-proofing strips, guides, bushings, needle valves, feeding fingers, serrated inserts for clamping devices, band-saw guides, etc.

Grade K12: Straight tungsten carbide containing high percentage of cobalt binder. Powder metal sintered forms. Not heat treatable. Trans str, 350,000 psi; comp str, 660,000 psi; Young's mod of elas, 77,000,000 psi; ys, 350,000 psi; endurance limit about 100,000 psi; Rock hdns, C74; sp gr, 14.05; magnetic permeability, 3.7; resistance to corrosion excellent at room temperature; max cont serv temp, 1200 F; abrasion resistance, high. Applications similar to that of Grade K6, but where greater transverse strength is required. Most shock proof of all Kennametal grades.

Grade K18: Straight tungsten carbide with higher percentage of cobalt. Trans str, 385,000 psi; compr str, 572,000 psi; Young's mod of elas, 71.9 x 10^6 psi; Rock hdns, C73; sp gr, 13.81. Has high impact resistance. For dies.

Grade KE5: Special straight tungsten carbide-cobalt composition for extruded forms only. Rock hdns, C76. Strength compares favorably with similar commercial grades. Produced in small rods or tubes of uniform cross section, suitable for use in gage elements, pins, pivots, feeding fingers, guides, and other small parts to which extruded forms can be adapted.

Grade KE7: Similar to KE5, but with Rock hdns, C79.

KENTANIUM (Titanium carbides)—Kennametal Inc., Latrobe, Pa.

Typical uses: Hot spinning tools for steel tubing; thermocouple protection tubes for

molten metal; valve seats for internal combustion engines; special high-temperature resistance heating elements; hot extrusion dies for copper and other alloys. Furnace parts for conveying hot metal. Supporting pins for enameling furnaces. Bushing and shear for guiding and cutting off hot rod. Formed and sintered. Available in several different compositions, each having a specific combination of properties to meet a particular operating condition.

Grade K138: Straight titanium carbide with cobalt binder. Trans str at room temp, 175,000 psi; at 1800 F, 100,000 psi; comp str, 550,000 psi; Young's mod of elas, 55,000,000 psi; Rock hdns, C 77.0; sp gr, 5.5. For conditions where oxidation is not severe, and strength at max room temperature only is required.

Grade K138A: Composed chiefly of titanium carbide, small percentage of other carbides, and cobalt. Has properties similar to K138 but adapted for conditions where oxidation is severe, and high strength and thermal shock resistance are required.

Grade K141A: Has greater percentage of cobalt than K138A. Not as hard (C 71.0), but has greater trans str (190,000 psi). High resistance to oxidation, max, thermal shock and impact resistance.

Grade K150A: Carbide composition same as other grades, but with nickel binder. High hardness, high oxidation resistance, medium strength, and thermal shock resistance. Withstands higher temperatures than K138A and K151A without plastic deformation.

Grade K151A: Has higher percentage of nickel than K150A. Not as hard (C 74.0) but stronger (trans str 175,000 psi at room temp). Highest resistance to oxidation and thermal shock of all listed Kentanium grades.

KENSICO (Copper tubing)—Kensico Tube Co. Inc., Mt. Kisco, N. Y.

Cu 99.90, P 0.025. Properties in soft condition: Ts, 32,000 psi; ys, (0.5% offset), 10,000 psi; elong in 2 in., 45%; Rock hdns, F40. Properties in hard condition: Ts, 55,000 psi; ys, (0.5% offset), 50,000 psi; elong in 2 in., 8%; Rock hdns, B60. Machinability, fair; weldability, good. Tubing for water and refrigeration, heat exchangers and oil burners.

KEY (Graphite paste)—Key Co., East St. Louis, Ill.

Semifluid joint sealing compound used for sealing threaded and gasket joints in oil lubrication systems, gear housing joints and similar connections. Insoluble in oil and other petroleum liquids.

KEYSTONE (Powdered metal parts)—Keystone Carbon Co., Inc., Saint Marys, Pa.

Machine parts (ferrous and nonferrous) with closely controlled dimensions and special wear, hardness, strength, electrical and friction properties by powder metallurgy.

KEY-TITE (Waterproof pipe-joint compound)—Key Co., E. St. Louis, Ill.

A semifluid joint sealing compound for use on hot and cold water lines, gas, air and low pressure steam services.

KGI (Glass)—Kopp Glass Inc., Swissvale, Pa.

Glass for marine, aviation, railroad and industrial applications. Types include technical glass, ultra-violet glass, heat-resisting glass, colored glass, crystal clear glass and opal glass.

KIDD (Steels)—Kidd Drawn Steel Co., West Aliquippa, Pa.

Flats, squares and special shapes in SAE grades, special alloys and open hearth and electric furnace tool steels. Analyses, characteristics and properties depend on grades of material, and according to customers' specifications.

KINITE (Tool steel)—H. Boker & Co., Inc., N. Y. C.

High-carbon, high-chrome air-hardening tool steel furnished in bars, castings, forgings. At Rock hdns, C55; Comp str, 300,000 psi. Cast form: ts, 100,000 psi; bar form, 200,000 psi. For dies, cams, slitting cutters, etc.

KLEENKUT (Chromium steel)—Heppenstall Co., Pittsburgh.

Tool steel containing C 2 and Cr 12. For sheet knives for cold shearing light material.

KONIK (Copper-nickel-chromium sheet)—Continental Steel Corp., Kokomo, Ind.

Sheets. Resists corrosion. Sizes: Gage, 10 to 30; width, 48 in. max; length 144 in. max depending on gage.

KOPPERS (Adhesive for polystyrene)—Koppers Co. Inc., Chemical Division, Pittsburgh 19.

An adhesive for joints in which one element is polystyrene: In fluid form. Resistant to water, alkalies, acids, and lower alcohols and oils, when set; transparent; gives clear, bubble and craze-free autogenous joints as strong as the polystyrene itself. For bonding polystyrenes to paper, cardboard, fabric, glass, rubber, and certain other plastics.

KOPPERS CELLULOSE ACETATE (Thermoplastic molding material)—Koppers Co. Inc., Chemical Division, Pittsburgh 19.

Granules and pellets for injection molding and extruding. Abrasion resistance, high; resistant to water, low concentrations of alkalis and acids and petroleum solvent; max cont serv temp, 110-150 F.; flex str, 2000-14,000 psi (ASTM D 650); dielectric str, 250-450 (volts per mil inst); ts, 3000-10,000 psi; comp str, 5000-30,000 psi; impact str (Izod) 0.4-6.0 ft-lb per inch notch; in all colors and clear; moisture absorp, low; sp gr, 1.27-1.37; transparent, translucent and opaque; machinability, excellent; Rock hdns, M20-120; coef thermal exp'n, 10—15 x 10^{-5} inch/inch/degree C. Tough, resilient and resistant to impact; well-suited for strong, light-weight, thin-walled articles. For knobs, controls, dials, wheels, electrical insulation, shields, nameplates, washers, housings, etc.

KOPPERS ETHYL CELLULOSE (Thermoplastic molding material)—Koppers Co. Inc., Chemical Division, Pittsburgh 19.

Granules and pellets for injection molding and extruding. Abrasion resistance, medium; resistant to alkalis, weak acids, water and salt solutions; max cont serv temp, 135 F; flex str, 3000-12,000 psi (ASTM D 650); dielectric str, 400-600 (volts per mil inst); ts, 2000-10,000 psi; comp str, 8000-20,000 psi; impact str (Izod), 0.6-11.5 ft-lb per inch notch; all colors except clear; moisture absorp, low; sp gr, 1.07-1.18; transparent, translucent and opaque; machinability, good; Rock hdns, M25-90; coef thermal exp'n, 10-14 x 10^{-5} inch/inch/degree C. Excellent toughness and dimensional stability at low temperatures. For knobs, controls, trim, handles, nameplates, refrigerator breaker strips, etc.

KOPPERS POLYSTYRENE (Plastic molding material)—Koppers Co., Inc., Chemical Division, Pittsburgh 19.

Thermoplastic. Granules, beads and pellets for injection molding and extruding. Abrasion resistance, medium; resistant to water, alkalis, acids and lower alcohols and oils; flex str, 8-12,000 psi (ASTM D 650); dielectric str, 450-650 (volts per mil inst); ts, 5-9000 psi; comp str, 12-16,000 psi; impact str (Izod), 0.3-0.4 ft-lb per inch notch; all colors and clear crystal; moisture absorp, low; sp gr, 1.045-1.07; transparent, translucent and opaque; machinability, good; Rock hdns, M70-85; coef thermal exp'n, 6—8 x 10^{-5} inch/inch/degree C. A low-cost material having very desirable physical, electrical and chemical properties. Used for knobs, dials, control wheels, electrical insulation, shields, etc.

KOP-R-ARC (Coated welding rods) — Krembs & Co., Chicago 10, Ill.

Welding rods for joining copper alloys by metallic arc welding.

KORFUND (Vibration damping material)—Korfund Co. Inc., The, Long Island City 1, N. Y.

Base Isolator: Plate of pure natural cork strips or blocks, top and bottom surfaces bound with asphalt and asphalt felt. Static load range, 1000-3000 lb per sq ft. Can be cut with hand saw.

Balanced Isolator: Cork strips interspaced with load-balancing, sound insulating filler; amount of natural cork varied to suit loading. Top and bottom surfaces bound with asphalt and asphalt tile. Static load range, 400-1000 lb per sq ft. Can be cut with hand saw.

Panel Seismo Damper: Natural cork pads bonded to underside of heavy-gage sheet metal panel on which concrete is poured. Area and placement of cork determined for optimum loading in accordance with weight distribution. Static load range, 250-1400 lb per sq ft.

Heavy-duty Base Isolator: Special heavy-duty vibration and sound insulating material interspaced with natural cork strips and covered top and bottom with asphalt felt. Static load range. 3000-30,000 lb per sq ft.

Steel-bound Cork: Resilient mat of pure natural cork strips, bound in a reinforced steel frame. Static load range, 1000-3000 lb per sq ft.

KORRY-KROME (Leather)—J. W. and A. P. Howard Co., Corry, Pa.

Used for bumper blocks, polishing disks, leather packings and valve disks.

KOVAR A (Iron-cobalt-nickel alloy) — Westinghouse Electric Corp., East Pittsburgh, Pa.

Iron alloy with Ni 29, Co 17, and Mn 0.3. Ts, 89,700 psi; elong in 2 in., 25%; ys, 50,500 psi; high resistance to amalgamation with mercury and withstands high thermal shock. For any application demanding vacuum-tight, metal-to-glass joints.

KRALASTIC (Plastic-elastomer compound) — Naugatuck Chemical Div. of United States Rubber Co., Naugatuck, Conn.

For molding and extrusion. Panel moldings, terminal blocks, plugs, switches, dials, handles, etc.

Grade BE: Sp gr, 1.05; ts, 4.400 psi; flex mod elas, 230,000 psi; impact str (notched Izod), 8.0 ft-lb; Rock hdns, R 96; flex str, 7000 psi.

Grade BM: Sp gr 1.05; ts, 5,100 psi; flex mod elas, 250,000 psi; flex str, 7,000 psi; impact str (notched Izod), 4.3 ft-lb; Rock hdns, R 103.

Grade C: Sp gr 1.05; ts, 4.300 psi; flex mod elas, 160,000 psi; flex str, 5,000 psi; imp str (notched Izod), 10.0 ft-lb; Rock hdns, R 87.

KROMAL (Alloy tool steel)—Amalgamated Steel Corp., Cleveland 5, O.

No. 2: Special analysis tool steel. Rough bars or billets, finished rods or bars, and special forgings. Properties, unheat-treated: Ts, 128,000 psi; ys, 111,000 psi; elong in 2 in., 21%; magnetic; machinability, good; weldability, good; abrasion resistance, high. Retains high degree of toughness in heat-treated condition.

No. 3: Special analysis tool steel. Rough bars or billets and finished rods or bars. Properties, unheat-treated: Ts, 134,000 psi; ys, 115,000 psi; elong in 2 in., 19%; magnetic machinability, good; weldability, good; abrasion resistance, high. Good combination of hardness and toughness.

No. 4: Special analysis tool steel. Rough bars or billets, finished rods or bars and special forgings. Properties, unheat-treated: Ts, 137,000 psi; ys, 118,000 psi; elong in 2 in., 18%; magnetic; machinability, good; weldability, good; abrasion resistance, high. For applications requiring high resistance to wear and abrasion.

K-SPUN (Cast iron)—Koppers Co. Inc., Metal Products Div., Piston Ring Dept., Baltimore 3, Md.

Centrifugal castings to specification. Properties, heat treated: Ts, 70,000 psi min; ys, 70,000 psi; endurance limit, 38,000 psi; Rock hdns, B95-105. For piston rings and cylinder liners.

KWIKMETAL (Liquid solder)—Atomized Materials Co. Inc., Pittsburgh 22.

A metallic plastic surface solder consisting of atomized aluminum in plastic bond. Furnished as putty in cans. For filling pits, gouges, sand and air holes in castings, and for general smoothing foundations for painting over all fabricated metal designs. Also may be thinned with KWIKMETAL solvent for brush or spray application to metal as protective and decorative coating. Material resists corrosion caused by water, acids, oils, grease, gasoline, etc.

KYS-ITE (Thermosetting phenol - formaldehyde plastics)—Keyes Fibre Co., Waterville, Me.

K-100: Finished moldings. Abrasion resistance, medium; resistant to boiling water, mild alkali, mild acid, and most organic solvents; dielectric str, 55-60 (volts per mil inst); ts, 12,000 psi; comp str, 19,000-35,000 psi; flex str, 18,000 psi; moisture absorp, low; Rock hdns, E65-85; in medium and dark shades; sp gr, 1.39-1.45; opaque; machinability, good. A high impact strength material coupled with lustrous finish it can be used as handwheels, small structural parts and other machine parts.

K-300: Furnished same as K-100. Abrasion resistance, medium; resistant to boiling water, mild alkali, mild acid and most organic solvents; flex str, 7000-10,000 psi; dielectric str, 260-360 (volts per mil inst); ts, 45,000 psi; comp str, 16-25,000 psi; moisture absorp, low; in medium to dark shades; sp gr, 1.36 to 1.42; Rock hdns, E65-85; opaque; machinability, good. For intricate shapes, housings, machine covers, business machine frames, etc.

K-200: Furnished same as K-100. Abrasion resistance, medium; resistant to boiling water, mild alkali, mild acid and most organic solvents. Ts, 10,000-10,550 psi; comp str, 26,300-32,180 psi; Rock hdns, E65-85; moisture absorp, low; in medium and dark shades; sp gr, 1.38-1.43; opaque; machinability, good. A high impact strength molded-laminated material with lustrous finish, it can be used for trays, pans and relatively

flat shapes of uniform cross section.

LA-LED (Free machining steel)—La Salle Steel Co., Hammond, Ind.

Typical analysis: C 0.10, Mn 0.95, P 0.07, Pb 0.21. Cold finished bars for machining; machines approx 325 SFM. Open hearth steel with lead added. For all types parts produced by automatic screw machines.

LAMICOID (Thermosetting plastics laminate)—Mica Insulator Co., Schenectady 1, N. Y.

Thermosetting laminated sheets, rods and tubes; for machining and stamping into parts. Furnished highly polished or satin; abrasion resistance, high; moisture absorp, low; in natural and black; impact-resistant; dielectric strength, high, good mechanical properties. For gears, electrical and mechanical insulation, instruction charts, dials.

LAMINAC (Unsaturated polyester resin)—Plastics Dept., American Cyanamid Co., New York 20.

For laminating or casting. Various grades. Ts, 41,500 psi; comp str, 14,900 psi: imp str (flatwise) (Izod), 33 ft-lb; heat resistance depends on filler.

LAMINUM (Laminated shim stock)—Laminated Shim Co. Inc., Glenbrook, Conn.

Laminated shim stock in sheet form in commercial high brass and SAE 1010 steel.

LAMITEX (Laminated phenolic plastics) — Franklin Fibre-Lamitex Corp., Wilmington, Del.

Thermosetting. Sheets, rods or tubes in laminated form for machining, punching and screw machine work. Abrasion resistance, high; max cont serv temp, 300 F; dielectric str, 150-750 (volts per mil inst); ts, 7500-12,500 psi; comp str, 32,900-38,000 psi; moisture absorp, low; in black and natural; sp gr, 1.36-1.38; opaque. For all parts for radio, radar, communication systems, airplanes, vessels, tanks, trucks, automobiles, etc.

LA-SULPHITE 8640 (Steel)—La Salle Steel Co., Hammond, Ind.

C 0.38-0.43, Mn 0.75-1.00, P 0.04 max, S. 0.04-0.06, Si 0.20-0.35, Ni 0.40-0.70, Cr 0.40-0.60, Mo 0.15-0.25. Finished bars for machining. Oil quench, 1525-1550 F, temper to desired hardness. For gears, splines, shafts, axles, etc.

LAVITE (Steatite ceramic) — D. M. Steward Mfg. Co., Chattanooga 1, Tenn.

For molding, machine, and extruding. Abrasion resistance, high; nonflammable; flexibility, low; dielectric str, 235 (volts per mil inst); ts, 7200 psi; comp str, 96,000 psi; flex str, 10,500 psi; moisture absorp, low; in white, opaque. Can be used as a substitute for metal, fiber or plastics parts for mechanical use, such as washers, bushings, etc.

LAVOLAIN (Ceramic) — Star Porcelain Co., Trenton, N. J.

Special molded shapes to specification. Abrasion resistance, high; chemical resistance, high; max cont serv temp, to 1200 F; ts, 6000 psi; moisture absorp, low; in the colors white and brown; not shatterproof; sp gr, 2.4; opaque; machinability, poor. A dense material of high mechanical strength and excellent resistance to rapid heat changes. Used for heat units in electric ovens, roasters, toasters, irons, heaters, etc.

LECTRO-PAT (Aluminum pattern alloys) — The Cleveland Electro Metals Co., Cleveland 13.

Aluminum alloys to specification in the form of pig or ingot, rough bars or billets, and permanent-mold castings.

LEDALOYL (Powder metal bearing alloys) — Johnson Bronze Co., New Castle, Pa.

Cu 83-85, Sn 9.5-10.5, Pb 2-4 and graphite 1.5 max. Powder metal parts to specification. Properties, untreated: Ts, 7-12,000 psi; comp str, solid block, 57-70,000 psi; or for hollow section, 35-50,000 psi; elong in 2 in., 2-5%; bhn, 35-45; sp gr, 6.4-7.2; nonmagnetic; weldability, fair; max cont serv temp, 275 F max; abrasion resistance, high. For bearing applications in all types of industrial and household equipment where lubrication is remote or likely to be neglected.

LEKTROKAST (Alloy iron casting) — Detroit Gray Iron Foundry, Detroit 7, Mich.

Sand castings to specifications. Ts, 40-50,000 psi; bhn, 200-240; weldability, fair. Used for dies (mainly deep drawing), gears, etc.

LEKTROMESH (Metal plated screening)—C. O. Jelliff Mfg. Corp., Southport, Conn.

One-piece solid metal-plated screen made by electrodeposition; 100 ft rolls up to 35 inches in width of 40-120 mesh; smaller units in 150-400 mesh; furnished in nickel and copper. For strainers in fuel systems, dry-screening, etc.

LENK SUPER ALUMINUM SOLDER — The Lenk Mfg. Co., Boston 15.

Solder in rods 3/16-in. diam by 17 in. long and in bars ⅜-in. square by 14 in. long. Low melting point; requires no acids or flux. Used for soldering aluminum to aluminum and aluminum to any metal that can be soldered.

LETHER-TECH (Laminated) — Technical Ply-Woods, Chicago 1.

Thermosetting: Embossed leather design in Spanish, walrus and alligator. Sheet for simple molding. Abrasion resistance, excellent; resists corrosion, repels termites; heat resistance, good; bonded at 350 F; flexibility, good; dielectric str, high; tensile and compr str, good to excellent depending on construction; moisture absorp, fair—excellent when treated; machinability, excellent. In stock colors, gray, red, green, black or white. Pigmented to match in large quantities.

LIGNUM-VITAE (Tropical wood) — Lignum, Vitae Products Corp., Jersey City, N. J.

Natural tropical wood, 30% volume is natural self-lubricating resin. Boards or logs for machining. Abrasion resistance, medium; resists corrosion caused by chemicals and light solutions; max cont serv temp, 150 F; flexibility, low; moisture absorp, low; in natural colors; sp gr, 1.33; opaque; hardness, 3-4 Moh's scale; soluble in alcohol and acetone. For bearings, bushings, rollers, guides, etc., where lubrication is difficult or impossible.

LIME (Babbitt metal) — Randall Graphite Bearings Inc., Chicago 6.

General purpose bearing metal also used as a substitute for regular genuine babbitt on shock load engine bearings. Properties: Ult str, 16,580 psi; ys, 7,750; bhn, 24.

LITECOTE (Welding rod)—Harnischfeger Corp., Milwaukee 14, Wis.

Mild steel welding rods for welding structural steels. Ts of joints, 55-60,000 psi; ys, 40-45,000 psi.

LITHLEAD (Bronze)—Lithium Co., Newark 4, N. J.

Cu 64.6, Pb 35.4 Ingots or pigs rough bars or billets, as sand, permanent mold, and precision castings, powder metal and finished bearings. Ts, 13,800 psi; comp str, 40,000 psi; elong in 2 in., 26.5%; bhn, 27.1-28.4; nonmagnetic; max cont serv temp, 250 F. For bearings, brake linings, etc.

LITTITE (Alloyed gray iron)—Littite Foundries Inc., Port Huron, Mich.

Properties, stress relieved: Ts, 30-35,000 psi; bhn, 196-288; machinability, good. A close-grained, non-porous iron suitable for a wide variety of cast machine parts.

LMC (Copper-base alloys) — Lewin-Mathes Co., St. Louis 2.

Pure electrolytic copper, brass and bronze mixtures, cupro-nickel; available in tubing. Used for all copper and brass tubing purposes.

LOF (Industrial plate glass)—Libbey-Owens-Ford Glass Co., Toledo, O.

Polished plate glass: Flat, bent and laminated form. Clear and in colors; sp gr, 2.49; highly polished; high dielectric strength. For viewing windows.

Window glass: Flat-drawn sheet form. Abrasion resistance, high; corrosion resistant (except to hydrofluoric acid); flexibility, medium; transparent; clear. Mod. of rupture, 6000 psi; sp gr, 2.49; annealed. For instrument dials, microscope slides, film projectors, etc.

Safety glass: Glass and plastic interlayers. Abrasion resistance, high, max cont serv temp, 150 F; flexibility, medium, transparent. For machine guards, observation and inspection windows, transparent barriers, etc.

LOGAN (Forging brass)—Titan Metal Mfg. Co., Bellefonte, Pa.

Cu 59, Pb 2, Zn balance. Ts, 61,000 psi; ys, 32,000 psi; elong, 40%; Rock hdns, B58. Machinability, excellent; corrosion resistance, fair.

LORD (Rubber-bonded-to-metal) — Lord Mfg. Co., Erie, Pa.

Mountings for isolation of vibration in industrial machinery. Includes mountings for shock protection of equipment during shipment. Many types available for specialized application; custom parts of rubber or neoprene bonded to metal to specification.

LOUTHAN (Ceramic insulations)—Louthan Mfg. Co., The, East Liverpool, O.

Dry-pressed special shapes to specification. Abrasion resistance, medium; resistant to all acids except hydrofluoric; max cont serv temp, 2200-2800 F; nonflammable; flexibility, low; dielectric str, 230-250 (volts per mil inst); flex str, 3000-17,000 psi; moisture absorp, 0-16%; produced in gray, white, brown and black; sp gr, 2.6-3.5; opaque; machinability, fair; coef thermal exp'n less than ½ of 1% at 1000 C. For electrical and heat insulators.

LUBRIK (Copper-tin-lead alloy) — Pittsburgh Brass Mfg. Co., Pittsburgh 1.

Cu 85, Sn 10, Pb 2.5 and Zn 2.5. Rough bars or billets, for turning, boring, etc; bhn, 69. For heavy-duty bronze bearings. Hardened by addition of nickel.

LUCITE (Acrylic resin) — E. I. duPont de Nemours & Co. Inc., Polychemicals Dept., Wilmington, Del.

Methyl-methacrylate thermoplastic: Sheets, rods, tubes and molding powder. Moldable into machine parts by all molding processes and by casting and extruding. Abrasion resistance, medium; chemical resistance to water, weak acids and weak alkalies; not resistant to lower ketones, esters, aromatic hydrocarbons, strong acids, or strong alkalies. Max cont serv temp (unloaded), 190 F; flex str, 12-16,000 psi (D790-44T); dielectric str, 400 (volts per mil inst); ts, 7-9500 psi; impact str (Izod), 0.4-0.5 ft-lb; in unlimited colors, transparent, translucent, opaque; moisture absorp, medium; sp gr, 1.18; Rock hdns, M87-102; coef thermal exp'n, 7.2-10.8 x 10^{-5} in./in./deg C. For guards, chemical tanks, enclosures, models, automatic heater and lubricator parts, etc.

LUKENS (Steels and steel products)—Lukens Steel Company, Coatesville, Pa.

Includes: Wide plates up to 195 in. wide, widest lightest plates, wide thick plates, heavy plates, flanged and dished heads and pressings. Also the following:

ALLOY STEELS: Complete line of openhearth steels (including AISI and SAE grades) as follows:

2% Nickel steel: Plates and spun and pressed heads. Untreated: Ts, 65-80,000 psi; ys, ½ of ts, elong in 2 in., 25%; bhn, approx 140; for hot forging, stamping, hot or cold working, riveting, turning, boring, etc., into many types of machine parts where a high-tensile steel of good ductility for low-temperature service is required.

Chrome-manganese steel: Plates and spun and pressed heads. Heat treated: Ts, 100-120,000 psi; ys, 65,000 psi min. Used principally in fan blades and fan rings or wherever any abrasion-resisting or high-stress properties are involved. For hot working.

3½% Nickel steel: Plates and spun and pressed heads. Untreated: Ts, 70-90,000 psi; ys, ½ of ts; elong in 2 in., 25%. Used where good resistance to impact is desired in parts operating in subzero temperatures.

Manganese-vanadium steel: Plates and spun and pressed head. Untreated: Ts, 90,000 psi max; ys, 45,000 psi min; elong in 2 in., 20%; high-tensile steel with good welding properties. Used in construction of antiaircraft gun mounts and carriages as well as military tank parts.

Chromium-nickel-molybdenum steel: Plates and heads. Untreated: Ts, 90-110,000 psi; ys, 50,000 psi; elong in 2 in., 20%; bhn, approx 195; magnetic; weldability, fair; abrasion resistance, high. For abrasion resisting parts at high temperatures where high stresses are involved.

Nickel-chromium steel: Plates and heads. Untreated; Ts, 80-100,000 psi; ys, 50,000 psi, min., elong in 2 in., 20%; bhn, approx 140; magnetic; weldability, good; abrasion resistance, medium. For parts requiring good ductility.

0.50 Molybdenum steel: Plates and heads, Untreated: Ts, 65-80,000 psi; ys, ½ of ts; elong in 2 in., 25%; bhn, approx 140; magnetic; weldability, good; abrasion resistance, medium. For parts requiring high physical strength at high temperatures.

Chromium - copper - nickel steel: Plates and heads. Heat treated: Ts, 65,000 psi, min; ys, ½ of ts; elong in 2 in., 25%; bhn, approx 140; magnetic; weldability, good; abrasion resistance medium. For parts operating at low temperatures.

8½% Nickel steel: Plates and heads. Heat treated: Ts, 90-110,000 psi; ys, 70,000 psi min; elong in 2 in., 20%; bhn, approx 200; magnetic; weldability, good; abrasion resistance medium. For parts operating at extremely low temperatures.

Chromium - molybdenum steel: Plates and heads. Untreated: Ts, 70-90,000 psi; ys, 45,000 psi, min; elong in 2 in., 20%; bhn, approx 160; magnetic; weldability, good; abrasion resistance, medium. For high-strength parts requiring good heat resistance.

Manganese - vanadium - titanium steel: Plates and heads. Untreated: Ts, 85,000 psi max;

ys, 45,000 psi min; elong in 2 in., 20%; bhn, approx 175; magnetic; weldability, good; abrasion resistance, high. Principally for marine applications.

CARBON STEELS: All standard openhearth carbon steels including AISI and SAE specification steels.

CLAD STEELS: Nickel-Clad, Stainless-Clad (all standard types of stainless steels) stainless "20"-clad Inconel-Clad and Monel-Clad Steels.

LUMAPANE (Cellulose acetate sheets reinforced)—Celanese Corp. of America, New York 16, N. Y.

Cellulose acetate sheets reinforced with wire mesh. Overall thickness, 0.030-in.; bursting strength over 200 psi; less than 1% dimensional change due to temperature variations between —40 F and 150 F and varying humidities. Total light transmission over 50%.

LUMARITH (Cellulose acetate base plastics)—Celanese Corp. of America, Plastics Div., New York 16.

Cellulose acetate molding materials, thermoplastic. For compression, injection and extrusion molding. Unlimited color in wide variety of formulations including heat and flame-resisting types; high polish; flexible; resistant to shock and corrosion; high impact strengths. For housings, interior electrical parts, automotive and radio knobs and handles, instrument lenses, etc.

Also films 0.0007 to 0.0002-in and sheeting 0.003 to 0.002-in for laminating, swaging, drawing or stamping into parts. Corrosion resistant; flexible; dielectric str, 700-2500 (volts per mil inst); ts, 4500-11,000 psi; max cont serv temp, 210 F; slow burning to nonflammable; transparent. Used for electrical parts, laminated slot insulation, coil winding, wire insulation, windshields, etc.

LUMEN ALLOYS (Bearing bronzes) — Lumen Bearing Co., Buffalo 12 (Note: "Lumen Alloy," together with each of the following materials. Thus, "Lumen Alloy No. 00A," which should be used in specifying these numbers and grades is a copyrighted term etc.)

Nos. 00A and 00C: High tin bronzes for high compression bearing applications.

No. 1: Zinc bronze for pressure castings including spur and bevel gears.

No. 2: Zinc bronze for machine parts, bearings, etc.

No. 3: Zinc bronze for mine service and paper mill machinery and bearings.

No. 4: Phosphor bronze (leaded) for bearings.

No. 4: (chill cast). For heavy-duty bearings.

No. 4A: High-phosphorus bronze (leaded) for bearings on hard steel.

No. 5: General service casting alloy; red brass; for low pressure valve bodies, etc.

No. 7: Phosphor bronze; uses include trolley wheels and castings to be nickel or chromium plated.

No. 9: Manganese bronze for machine parts requiring strength, electrical conductivity, and high pressure.

No. 11-C: (sand cast). Aluminum bronze. For miter, bevel gears and bearings subject to impact.

No. 11-C: (heat treated). Ts, 65-100,000 psi; recommended where strength, corrosion and heat resistance are required.

No. 14: Zinc bronze, babbitt backing. For valve bodies, etc.

No. 15: Phosphor bronze. For worm wheels, bearings, etc.

No. 15: (chill cast). For worm gears, nuts and bearings.

No. 15A: Phosphor bronze (slightly leaded). For worm wheels, bearings, etc.

No. 15A: (chill cast). For heavy-duty bearings and worm gear castings.

No. 20: Super-manganese bronze. For machine parts requiring extra strength.

No. 31: For high-speed, low-duty bearings.

No. 33: For bearings, high-speed, low-duty.

No. 43: Nickel-tin-bronze alloy for bearing, gears and nuts; abrasion-resistant.

No. 43: (chilled). Nickel-tin-bronze for bearings, worm gears and nuts with higher tensile strength than No. 43.

No. 48: Nickel-phosphor-bronze. For bearings used with hardened steel, worm wheels, etc.

No. 48: (chill cast). For bearings, worm gears, nuts, slippers, etc.

No. 54: Phosphor bronze (leaded) for bearings and worm wheels for intermediate service.

No. 54: (chill cast). For bearings, worm gears, nuts, etc.

No. 96: Aluminum bronze. Approx Cu 88.0, Al 8.5, and Fe, 3.5. Ts, 73,000 psi; ys, 25,000 psi; bhn, 114-121; sp gr, 7.7; abrasion resistance, medium.

LUMITE (Industrial fabrics) — Chicopee Mfg. Corp. of Georgia, 47 Worth St., New York, N. Y.

Vinylidene chloride thermoplastics in woven fabric: Resistant to acid, most alkalies, solvents, oils and greases; max cont serv temp, 225 F; flex str, good; dielectric strength; 500 (volts per mil inst); ts, 25-40,000 psi; in all colors; sp gr, 1.72; translucent and opaque. Fabrics are woven of Dow Chemical Company's Saran and are used for straining, filtering, sieving, conveyor belts, etc. Industrial and specialty woven screen and fabrics of nylon, vinyon N, Dynel, rayon and other synthetic mono and multi-filament materials are also available.

LUSTREX-L (Styrene thermoplastic plastics) — Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Powder for molding into parts. Abrasion resistance, fair; can be highly polished; corrosion resistant; dielectric str, 500-700 (volts per mil); ts, 6000-7000 psi; moisture absorp, low; in color; sp gr, 1.054-1.070; clear to opaque. For electrical insulating parts, etc.

LUSTREX-LX (Polystyrene molding plastics) — Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Flexural str, 9000-11,000 psi; sp gr, 1.05; dielectric constant (1 megacycle), 2.5-2.7; power factor (1 megacycle), 0.0001-0.0005; water absorp (24 hours), 0.04-0.05%. No effect from weak acids and bases or strong bases; is attacked by strong oxidizing acids. Soluble in esters, aromatics, higher alcohols, chlorinated hydrocarbons. Any color desired, in opaque, translucent or transparent.

LUZERNE (Hard rubber)—Luzerne Rubber Co., Trenton, N. J.

Thermoplastic: Sheets, rods or tubes for machining into parts. High polish; corrosion-resistant to acids and alkalies; dielectric str, 6 x 10^7 megohms constant at 28.8 C; ts, 3500-9000 psi; max cont serv temp, 120 F; in some colors; sp gr, 1.24; comp str, 8000-12,000 psi. For electrical, chemical, medical and other parts requiring high dielectric strength.

M-13 (Magnesium-base die castings)—Precision Castings Co. Inc., Syracuse, N. Y.

Al 9.0 Mn 0.13, Zn 0.6, Si 0.5 max. with magnesium base. Die castings: Ts, 33,000-34,000 psi; ys, 21,000 psi; elongation, 2 to 5 (3 av.) % in 1 or 2 inches; imp str, low; bhn, 60; sp gr, 1.81; nonmagnetic; corrosion resistance, fair; max cont serv temp, 700 F; abrasion resistance, medium.

MACHEMPITE (High strength castings)—Mackintosh-Hemphill Co., Pittsburgh.

C 0.3-1.25, Mn 1.25-1.75, Mo 0.25-0.75 Castings. Ts, 85-125,000 psi; ys, 65-100,000 psi; elong, 25-5%; impact resistance, low; bhn, 215-400; magnetic; weldability, good; abrasion resistance, medium. For gears, pinions, hammer dies, etc.

MACHINERY BRONZE—Gilbert Brass Foundry Co., St. Louis 15, Mo.

Cu 85, Sn 5, Pb 5, Zn 5. Rough bars or billets, finished rods or bars and sand castings. Properties unheat-treated: Ts, 35,000 psi; ys, 16,000 psi; elong in 2 in., 20%; bhn, 50 (500 kg); sp gr, 8.80; nonmagnetic; machinability, good; weldability, fair; max cont serv temp, 450 F; abrasion resistance, medium. For valves pump parts, bearings, plumbing fittings, brewery fittings, general all-purpose industrial castings.

MAGICORES (Powder iron)—Henry L. Crowley & Co., West Orange, N. J.

High-frequency powdered iron cores for radio and electrical applications.

MAGIC GLAZE and SPOT PUTTY (Plastic filler for metal)—Magic Iron Cement Co., Cleveland 14, O.

Paste made of synthetic resins for filling fine indentations or flows in any metal. Sets quickly and has great adhesion to bare metal or painted surfaces. Can be painted or lacquered.

MAGIC IRON CEMENT—Magic Iron Cement Co., Cleveland.

Metal filler and adhesive made of powdered iron and binder. For plugging leaks in boilers, fire pots, etc., and for filling in pitted castings or any other pitted metals.

MAGIC PLASTIC BODY SOLDER—Magic Iron Cement Co., Cleveland.

Made of plastic resins, applied in putty form. Fast drying, easy to use. For filling in flaws, holes, etc., in metals.

MAGIC PLASTIC LEAD (Caulking compound)—Magic Iron Cement Co., Cleveland.

Made of plastic resins. Dries fast and has great strength. For caulking soil pipe joints, etc. Will withstand great pressure.

MAGNOLIA NO. 120 (High lead bearing bronze)—Magnolia Metal Company, Elizabeth, N. J.

20% lead bearing bronze for medium and light-load bearings where lubrication is difficult. Die-cast and machined on all surfaces; fine dispersion of lead particles, free of porosity. Bar stock in ⅛-in. diam steps from 1 in. to 19 in. O.D. up to 40 in. long; also cylindrical shapes semifinished or finish machined to specification. Bhn, 54; ys, 12,000 psi.

MAGNOLIA AA (Hard bearing bronze)—Magnolia Metal Company, Elizabeth, N. J.

Lead-free bearing bronze for gears and extremely tough bearing applications; diecast and machined on all surfaces; unusually fine crystalline structure, free of porosity. Bar stock in ⅛ in. diam steps from 1 in. to 19 in. O.D. up to 40 in. long; also cylindrical shapes semifinished or finish machined to specification. Bhn, 85; ys, 30,000 psi.

MAGNOLIA ANTI-FRICTION METAL (Babbitt)—Magnolia Metal Company, Elizabeth, N. J.

Graphite-treated, general-purpose babbitt, largely self-lubricating for bearings with steady high speeds and heavy loads. Particularly recommended for ahead-and-reverse action bearings and for use with water lubrication. Absorbs grit and runs cool. 80% lead-babbitt, copper-free; bhn, 21.8; ys, 5,440 psi; pouring temp, 925-1000 F.

MAGNOLIA ISOTROPIC (Die-cast bearing bronze)—Magnolia Metal Company, Elizabeth, N. J.

General-purpose leaded bearing bronze, die-cast and machined on all surfaces, with fine dispersion of lead particles and free of porosity. Bar stock in ⅛ in. diam steps from 1 in. to 19 in. O.D. up to 40 in. long; also cylindrical shapes semifinished or finish machined to specification. Bhn, 70; ys, 26,000 psi.

MAIZEWOOD (Fiber insulation board)—Maizewood Insulation Co., Dubuque, Iowa.

Sheet form. Used as a sound deadener.

MAKEPEACE (Laminated precious metals)—D. E. Makepeace Co., Attleboro, Mass.

Laminated precious metals, consisting of any precious metals bonded to any nonferrous base metals, in strips (coiled), tubing, wire and sheets. For stamping, turning, boring, etc.

Sheet: Any combinations of metals and ratio; single or double plate or strip. As thin as 0.003-in. in widths ⅛-in. to 6 in., and within tolerances of 0.0001-in. to 0.0002-in., depending on material. Available with fine mirrored finish suitable for fine precision parts or decorative pieces. Coiled or flat, depending upon requirements, for any type of part.

Tubing: Of deep-drawn sheet, 0.015 in. to 2 in. OD, with wall thickness down to 0.005-in. very close tolerances on wall thickness and diameters. Used in electrical industry, for electronic applications, radio parts, delicate instrument assemblies, etc.

Special shapes also available (rectangular, octagonal, or star-shaped, etc.). Rings, sleeves and jackets can be cut from laminated tubes.

Wire: Diameters down to 0.005-in., depending on material. Shaped for use. In any shape for instruments, for formed, plated springs, radio electronic parts and in chemical apparatus when corrosion must be prevented.

Bar type contact tape: Contact tape from which bar type contacts can be made, furnished in palladium, silver, or palladium clad nickel, made under Western Electric license agreement. Bar contacts can also be attached to customers' springs or contact arms.

Laminated contact strip: Precious metal inlay, overlay, and raised lay, from which contact parts can be blanked. Can be furnished with a variety of precious metals laminated to such nonferrous metals as nickel silver, beryllium copper, or phosphor bronze, rolled to required temper. Contact parts can also be furnished made complete from these materials.

Waveguide tubing: Rectangular waveguide tubing furnished in solid precious metals or precious metal laminated on the inside of brass base tubing.

Collector rings: Rings can be made of solid precious metals or precious metals laminated to base metals. Laminated rings present operating economies and combine the strength and desirable qualities of various base metals, together with the corrosion resistance and contact properties of precious metals. Precious metal can be applied on

the outside or on the face of the collector ring.

MALARKEY PLYWOODS — M and M Wood Working Co., Portland, Ore.

Phenol-formaldehyde bonded plywood, thermosetting: Strong by unit weight; panel ¼-in. thick and 12-in. sq weighs approx 12 oz and supports over 400 lbs; widths to 72 in. (sanded) or 96 in. (unsanded); lengths to 144 in.; special scarfed panels to 50 ft. Thicknesses up to 9 in. made on high frequency thermal press for gusset plates, machine mountings, platforms, wood pulleys, spindles, etc. Cross-ply construction makes it splitproof and nails and screws can be fastened to very edge with safety. Moisture absorp, low. Used wherever rigidity and lightweight is needed. Bond is not affected by moisture, temperature, solvent, or exterior exposure. Available in Douglas Fir-Redwood. Also hardwood plywoods including bench oak, mahogany walnut, and vertical grain fir.

MALGA ELEKTRO SPECIAL (Alloy tool steel) —Amalgamated Steel Corp., Cleveland 5, O.

Special analysis tool steel rough bars or billets, finished rods or bars, and special forgings. Properties, unheat-treated: Ts, 168,000 psi; ys, 148,000 psi; elong in 2 in., 16%; magnetic; machinability, good; weldability, good; abrasion resistance, high. Combines toughness, strength and high hardness. For drift pins, studs, bolts, collets, etc.

MALGALOY (Alloy tool steel)—Amalgamated Steel Corp., Cleveland 5, O.

Tool steel rough bars or billets, finished rods or bars, and special forgings. Properties, unheat-treated: Ts, 108,000 psi; ys, 64,000 psi; elong in 2 in., 27%; magnetic: machinability, good; weldability, good; abrasion resistance, high. Has good shock and wear resistance.

MALGA M.R.O. SPECIAL (Alloy tool steel)—Amalgamated Steel Corp., Cleveland 5, O.

Special analysis tool steel rough bars or billets, finished rods or bars, and special forgings. Properties, unheat-treated: Ts, 160,000 psi; ys, 133,000 psi; elong in 2 in., 16% magnetic; machinability, good; weldability, good; abrasion resistance, high. Deep hardening, and develops high hardness, good wearing qualities and high shock resistance. For gears, arbors, spindles, shafts, etc.

MALGA NONTEMPERING SPECIAL (Alloy tool steel) — Amalgamated Steel Corp., Cleveland 5, O.

Special analysis tool steel rough bars or billets, finished rods or bars, and special forgings. Properties, unheat-treated: Ts, 166,000 psi; ys, 136,000 psi; elong in 2 in., 16%; magnetic; machinability, good; weldability, good; abrasion resistance, high. May be quenched over wide range of temperatures with satisfactory results in hardness and toughness for general-purpose applications without necessity of tempering.

MALLIX (Pearlitic malleable iron)—National Malleable and Steel Castings Co., Cleveland 6, O.

A grade of pearlitic malleable the properties of which include exceptional resistance to heat, abrasion and shock.

MALLORY (High-copper and high tungsten-base alloys)—P. R. Mallory & Co. Inc., Indianapolis.

Mallory 22: Precipitation-hardened copper-cadmium-zirconium alloy having high hardness and electrical conductivity. Specifically used as electrode or die material in resistance welding. Recommended for spot and seam welding of coated steels such as terne plate, galvanized iron, tin plate, etc., or in resistance welding applications where efficient cooling of electrodes is impracticable.

3 Metals: Patented copper-chromium-lithium alloy, used extensively for spot, flash and seam welding cold-rolled steel, stainless steel, nickel alloys and Monel metal, silicon bronze alloys, zinc, nickel-silver and other materials employed in applications where a high-strength, high-conductivity material is required. Rods, bars, strips and castings.

53B Metal: Copper-base alloy in castings and forgings only, Ts, 80-100,000 psi. For heavy duty butt-seam welding wheels, flash-welding dies, bearings and current and heat-carrying members in electrical and other machinery.

73 Metal: Rough and finished bars, sheets, castings and forgings containing 97% copper. Resists sea water. Ts, 110-170,000 psi. For bearings and bushings, vibrator arms, springs, spring washers and electrodes for projection welding.

100 Metal: Rough and finished bars, castings and forgings containing 97% copper. Recommended for highly loaded small gears, current-carrying bearings, springs, etc.

1000 Metal: Predominantly tungsten. Finished parts or blanks. Ts, 100,000 psi; impact resistance, medium; Rock hdns, C32-40; sp gr, 16.9-17.1; nonmagnetic. Max cont serv temp, 300 C; abrasion resistance, high. For small counter weights, gyroscope rings, etc.

MANGANAL (Manganese-nickel steel) — Stulz-Sickles Co., Newark 5, N. J.

11-13.5% manganese-nickel steel welding rod, applicator bars and hot-rolled plates. Ts, to 155,000 psi; ys, to 60,000 psi. For repairing such items as shovel teeth, buckets, chutes, crushers, steel mill coupling boxes, tractor parts, etc.

MANGANIN (Copper-manganese-nickel alloy)— Driver-Harris Company, Harrison, N. J.

Copper alloy having a temperature coefficient of resistance of .000015 between 15-35 C. and specific resistance of 290 ohms per cmf in the precision grade. Typical applications are as resistance bobbins in such instruments as Wheatstone Bridges, decade resistance boxes, and potentiometers. Another grade is used for shunts for D.C. ammeters.

MANGANWELD (Welding electrode) — Lincoln Electric Co., Cleveland.

Arc welding electrode that produces deposit of austenitic manganese-nickel-molybdenum steel. Suitable for hard-facing austenitic manganese steel parts containing 11-14% manganese, such as crusher parts, valves, turbine runners, pulverizer roll shafts, gathering and loading equipment.

MARBLETTE (Cast phenolic resin)—The Marblette Corp., L. I. City, N. Y.

Furnished in sheet, rod and tube form. Abrasion resistance, medium; decomposes in strong alkalies, slightly affected by strong acids; nonflammable; ts, 8-12,000 psi; moisture absorp, low; unlimited colors; sp gr, 1.30-1.32; transparent, translucent and opaque; machinability, good. For knobs, handles, various trim parts, etc.

Casting resin in fluid form for casting: Abrasion resistance, medium; max cont serv temp, 120 F; nonflammable; flexibility, low; ts, 60,000 psi; compr str, 10,000-12,000 psi; light ivory color; sp gr, 1.25; opaque; machinability, good. For forming dies and jigs.

MARBON "S" (Thermoplastics)—Marbon Corp., Gary, Ind.

Modified styrene thermoplastic: Granules for injection and compression molding. Abrasion resistance, high; max cont serv temp, 120 F; flex str (ASTM D 650-42T), 8000 psi; dielectric str (volts per mil inst), 1035-1060; ts, 5400 psi; color, amber; moisture absorp, low; sp gr, 1.05; translucent; machinability good.

MARCOBOARD (Plastics laminates) — Marco Chemicals Inc., Sewaren, N. J.

Polyester thermosetting laminates. Chemical resistance, excellent; moisture absorp, low; machinability, good.

MARQUETTE (Welding rods, brazing compounds and solders)—Marquette Mfg. Co. Inc., Minneapolis.

A complete complement of welding rods, brazing compounds and solders as follows:

No. 130 Red rod and No. 140 Production rod: Meets AWS Spec E 6011.

No. 151 White rod: Meets AWS Spec E 6013.

No. 101 Dust Cote rod: Meets AWS Spec E 4511. These welding rods (ac-dc) are used in the fabrication of sheet metal, pipe, tanks, boilers, structural steel, trucks, cars, farm equipment, etc.

No. 105 Positive rod: Meets AWS Spec E 6010.

No. 120 Code Rod: Meets AWS Spec E 6012.

No. 115 Hot rod: Meets AWS Spec E 6020. These are mild steel welding rods for joining all types of mild steel structures.

No. 9 aluminum rod is made of 43S aluminum. No. 8 aluminum rod is made of 2S aluminum. No. 80 and No. 70 flux coated aluminum rod is made of 43S aluminum. No. 716 aluminum brazing rod used for low temperature brazing. No 803 aluminum solder has high tin content. These rods are used for welding and brazing aluminum and aluminum alloys.

No. 85 Hy-test rod: Meets AWS Spec 8011. No. 110 Hy-test rod meets AWS Spec E 10011; No. 2512 nickeloy rod. These are chrome-moly-nickel alloy steel rods (ac-dc) used for welding low-alloy, high-tensile steels.

No. 308 Stain rod (ac-dc): Available in all types of stainless steel. Used for joining steels, high-alloy-content steels, high carbon steels, and armor plate.

No. 100 hard rod; No. 250 Mang rod; No. 450 hard rod; No. 550 hard rod; No. 650 tool rod. These are ac-dc rods used for all types of hard surfacing.

No. 1175: Silver solder; used for joining various ferrous and nonferrous metals.

Alladin die cast rod: Used for joining zinc or aluminum die castings.

Gas welding rod: No. 20. Tobin Bronze; No. 30, low fuming manganese bronze; No. 38, flux-coated nickel silver rod (white bronze); No. 1301, phosphor bronze; No. 39, nickel silver rod (white bronze); No. 32, flux coated brazing rod.

Ferrous gas welding rods: No. 1 and 2, mild steel; No. 3, high tensile rod; No. 4, 1% carbon steel rod; No. 5, cast iron rod; G 2512, 5% nickel rod; G 308, Type 308 stainless rod. For joining all types of steel, cast iron and stainless steels.

No. 44, Nicol rod; An ac-dc welding rod which gives machinable welds on cast iron, etc.

No. 42 cast rod: An ac-dc welding rod of cast iron.

No. 40 Blu-rod: Has a steel core wire for cast iron welding.

No. 61 bronze rod: A metallic arc rod for ac-dc brazing.

MARVEL (Hot-work die steel)—Vanadium Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

C 0.35, W 10.00, Cr 3.50, V 0.50, Si 0.25, Mn 0.25. Rough bars and billets, finished rods or bars, wire, sheet, plate, forgings and drill rod, for machining, hot and cold working, stamping, drawing and brazing. Properties, heat-treated state: Comp str 40,000 psi; imp str (Charpy), 40-60 ft-lb unnotched; Rock hdns, C46 max; sp gr, 8.2; magnetic, max cont serv temp, 1150 F; abrasion resistance high. For wearing parts used at high temperatures and subject to shock, high temperature springs, etc.

MAURATH (Stainless electrodes) — Maurath, Inc., Cleveland 22, O.

Stainless steel welding rods for welding stainless steels.

MAYARI R (Low-alloy, High-strength steels) — Bethlehem Steel Co., Bethlehem, Pa.

Meets requirements for ASTM A-2421. Resists atmospheric corrosion and abrasion. For many types of light-weight construction. Sheets, strips, plates, bars, structural shapes, rivets and bolts.

MAZLO (Magnesium alloys)—Aluminum Co. of America, Pittsburgh.

Available in sand, permanent-mold and die castings, extruded bar, shapes and structural sections, tubing, hollow sections, forgings, and anodes for cathodic protection, magnesium shavings, wire and ribbon.

AM240: Al 10, Mn 0.1, Mg remainder. For sand and permanent-mold castings. Supplied in as-cast, heat-treated and heat-treated and aged conditions.

AM260: Al 9, Zn 1, Mn 0.2, Mg remainder. Sand and permanent-mold castings. Supplied in as-cast, heat-treated and heat-treated and aged conditions. For moving parts on high-speed production equipment and wherever pressure tightness and good strength are needed. Good salt water resistance.

AM265: Al 6, Zn 3, Mn 0.2, Mg remainder. For high-strength sand castings requiring good chemical stability. Supplied in as-cast, heat-treated and heat-treated and aged conditions.

AM 263: Al 9, Zn 0.6, Mn 0.2, Mg remainder. For pressure die castings for light-weight parts in portable or fast-moving equipment.

AM3S: Mn 1.5, Mg remainder. For extruded shapes, sand castings, and hammer forgings of moderate strength for uses requiring maximum salt-water resistance. For fabricated articles such as aircraft oil tanks and cowlings.

AMC52S: Al 3, Zn 1, Mn 0.2, Mg remainder. For extrusions of light weight. Good welding and forming characteristics and salt-water resistance.

AMC57S: Al 6, Zn 1, Mn 0.15, Mg balance. For extruded bars, tubes and for light-weight applications in general.

AMC58S: Al 8, Zn 0.8, Mn 0.15, Mg remainder. For hot press forgings for parts under stress, especially for aircraft and aircraft engines.

AM59S: Al 10, Mn 0.15, Mg remainder. For extruded shapes in which highest possible hardness and yield strength in tension is required.

AM65S: Al 3.5, Sn 5, Mn 0.5, Mg remainder.

For hot press forgings of moderate strength and lightness.

AMSSS: Al 10, Zn 0.3, Mn 0.1, Mg remainder. For welding rod.

MCA (Alloying elements)—Molybdenum Corp. of America, Pittsburgh.

Ferro-Boron: Alloying material in irons and steels. In castings its use gives increased strength and machinability, and in the case of malleable iron, ease of annealing.

Molybdenum: Alloying element for use in steel and iron; imparts strength, toughness, ductility and resistance to abrasion; improves fatigue value, eliminates temper embrittlement, increases physical properties at elevated temperatures; molybdenum steel is easily welded and machined.

Tungsten: Alloying element for steel; imparts hardness, resistance to abrasion; cutting ability to tool steels. Used extensively as tungsten carbide where special cutting service is desired.

McKAY (Welding rods)—McKay Co., The, Pittsburgh 22, Pa.

2 Cr Mo: C 0.10 max, Cr 2, Mo 0.5. Arc welding electrodes for joining 2% chromium steel of AISI type. A martensitic steel with high hardness and moderate ductility as welded. Three coatings: DC lime, DC titania and AC-DC titania.

3 Electrode: Mild steel arc welding electrode for joining mild steel parts. For tack welding or high-speed production where maximum mechanical strength is not required. AWS E-4520.

5 Cr Mo: Arc welding electrode of stainless steel Type 502 plus 0.5 molybdenum. For joining stainless steels Types 501 and 502. Joint properties: Ts, 145,000 psi; ys, 125,000 psi; corrosion resistance similar to 85% chromium steel. A martensitic steel with high hardness and moderate ductility as welded. Three coatings: DC lime, DC titania and AC-DC titania.

9 Cr Mo: C 0.15 max, Cr 9, Mo 1.5. Arc welding electrodes for joining stainless, straight chromium steels up to 10% chromium. Joint properties: Ts, 145,000 psi; ys, 115,000 psi. Corrosion resistance similar to 9% chromium steel.

11: Mild steel arc welding electrode for joining mild steel parts. Joint properties: Ts, 67,000 psi; ys, 53,000 psi; bhn, 125. All-position deeply penetrating electrode for ac or dc current. AWS E6011.

12 Cr: Stainless Type 410 arc welding electrode for welding stinless Type 410 steel parts. Joint properties: Ts, 150,000 psi; ys, 135,000 psi. Martensitic steel with high hardness and moderate ductility as welded. Three coatings: DC lime, DC titania and AC-DC titania.

15: Mild steel arc welding electrode for joining mild steel parts. Joint properties: Ts, 69,000 psi; ys, 54,000 psi; bhn, 125. All-position deeply penetrating electrode for dc current. AWS E6010.

15-D: Mild steel arc welding electrode for welding mild steel parts. Joint properties: Ts, 70,000 psi; ys, 63,000 psi. Primarily for vertical down welding. Cellulose type coating.

15-35: Stainless Type 330 arc welding electrode for welding stainless Type 330 steel parts. Joint properties: Ts, 85,000 psi; ys, 57,000 psi. Austenitic alloy heat-resistant to 900 F and excellent corrosion resistance. Three coatings: DC lime, DC titania and AC-DC titania.

15-60: C 0.10 max, Ni 60, Cr 15. Arc welding electrode for welding stainless steel type Nichrome parts. For extreme high-temperature service and for handling certain corrosive liquids.

16 Cr: Type 430 stainless steel arc welding electrode for joining Type 430 stainless steel parts. Joint properties: Ts, 120,000 psi; ys, 90,000 psi. Structure of martensite plus ferrite. Three coatings: DC lime, DC titania and AC-DC titania.

16FBS: Mild steel arc welding electrodes for joining mild steel parts. Mineral-coated electrode designed for high-speed intermittent welding. Restrikes much more easily than the normal mineral-coated electrode.

16-25-6: Complex Cr, Ni, Mo, Mn, Si Fe alloy arc welding electrode for welding parts of Timken 16-25-6 alloy. For high-temperature service such as encountered by turbine and jet engine parts.

17: Mild steel arc welding electrode for joining mild steel parts. Joint properties: Ts, 70,000 psi; ys, 55,000 psi; bhn, 156. All-position, shallow-penetrating rod for dc current. AWS E6012.

18: Mild steel arc welding electrode for joining mild steel parts. Joint properties: Ts, 70,000 psi; ys, 62,000 psi. Mineral-coated for ac or dc; for flat position only. AWS 6030.

18 Cr: Stainless Type 442 arc welding electrodes for joining stainless Type 442 steel parts. Joint properties: Ts, 85,000 psi; ys, 70,000 psi. A ferritic steel. Three coating types: DC lime, DC titania and AC-DC titania.

18-8: Arc welding electrodes of material similar to Type 308 stainless steel. For joining stainless steel Types 301, 302, 304, 305, 308. Joint properties: Ts, 89,000 psi; ys, 63,000 psi. Three coating types: DC lime, DC titania and AC-DC titania.

18-8 Cb: Arc welding electrodes of material similar to Type 347 stainless steel. For welding stainless steel Types 321 and 347. Joint properties: Ts, 97,000 psi; ys, 73,000 psi. Three different coatings: DC lime, DC titania and AC-DC titania.

18-8 Cb ELC: Arc welding electrode of material similar to stainless Type 347 but with extra low carbon content. For joining stainless steels Types 308 ELC or 347. Joint properties: Ts, 90,000 psi; ys, 70,000 psi. Two coatings: DC lime and DC titania.

18-8 Mo (Type 316): Arc welding electrodes of material similar to Type 316 stainless for welding Type 316 stainless parts. Joint properties: Ts, 80,000 psi; ys, 56,000 psi. Three coating types: DC lime, DC titania and AC-DC titania.

18-8 Mo Cb (Type 316 + Cb): Arc welding electrodes of material similar to stainless Type 316 for welding stainless Type 316 parts. Joint properties: Ts, 85,000 psi; ys, 68,000 psi. Three coatings: DC lime, DC titania and AC-DC titania.

18-8 Mo ELC (Type 316 ELC): Arc welding electrodes of material similar to Type 316 but with extra low carbon content. For welding stainless steel Types 316 or 316 ELC. Joint properties: Ts, 80,000 psi; ys, 55,000 psi. Two coatings: DC lime and DC titania.

18-8 Mo ELC (Type 317 ELC): Arc welding electrodes of material similar to Type 317 stainless but with extra low carbon content. For welding stainless steel Types 316, 317, 316 ELC. Joint properties: Ts, 100,000 psi; ys, 75,000 psi. Two coatings: DC lime and DC titania.

18-8 Mo ELC (Type 317): Arc welding electrodes of material similar to stainless Type 317 for welding stainless types 316 or 317. Joint properties: Ts, 97,000 psi; ys, 70,000 psi. Three coatings: DC lime, DC titania and AC-DC titania.

18-8 ELC: Arc welding electrodes of material similar to Type 308 stainless but with extra low carbon content. For welding stainless steel Types 301, 302, 305, 308 and any of these in ELC form. Joint properties: Ts, 85,000 psi; ys, 55,000 psi. Two coatings: DC lime and DC titania.

19: Arc welding electrodes of very low carbon steel for welding cast iron parts. For nonmachinable welds in cast iron. Weld exceeds strength of the cast iron.

19-9 W Mo: Arc welding electrodes of complex 18-8 modified steel for welding stainless steel Type 19-9 WX. Joint properties: Ts, 110,000 psi; ys, 84,000 psi. For high-temperature service such as is encountered by turbine and jet engine parts.

20: Arc welding electrodes of mild steel for joining mild steel parts. Joint properties: Ts, 64,000 psi; ys, 53,000 psi; bhn, 139. For down-hand and horizontal fillet welding. Deep penetration, ac or dc current. AWS E6020.

20H: Arc welding electrodes of mild steel for welding mild steel parts. Joint properties: Ts, 70,000 psi; ys, 62,000 psi; for final pass on multiple-pass joint. Mineral coated, for ac or dc; provides smooth bead; for flat position and horizontal fillets only.

20-80: Arc welding electrodes for welding stainless steel Nichrome V. Excellent heat resistance; used for heat treating containers.

21: Arc welding electrodes of mild steel for welding mild steel parts. Joint properties: Ts, 55,000 psi. For tack welding or high-speed production where maximum mechanical strength is not required. AWS E4510.

24: Mild steel arc welding electrode for joining mild steel parts. Joint properties: Ts, 73,000 psi; ys, 60,000 psi; AWS E6013.

25-12: Arc welding electrodes of materials similar to stainless Type 309 for welding stainless steel Type 309 parts. Joint properties: Ts, 82,000 psi; ys, 56,000 psi. Three coatings: DC lime, DC titania and AC-DC titania.

25-12 Cb: Arc welding electrode of material similar to stainless Type 309 plus columbium. For welding parts of stainless steel Type 309. Joint properties: Ts, 88,000 psi; ys, 68,000 psi. Three coatings: DC lime, DC titania and AC-DC titania.

25-20: Arc welding electrodes of materials similar to stainless Type 310 for welding parts of stainless steel Type 310. Joint properties: Ts, 85,000 psi; ys, 57,000 psi. Three coatings: DC lime, DC titania and AC-DC titania.

25-20 Cb: Arc welding electrodes of materials similar to Type 310 plus columbium for welding stainless steel Type 310 parts. Joint properties: Ts, 90,000 psi; ys, 68,000 psi. Three coatings: DC lime, DC titania and AC-DC titania.

25-20 Mo: Arc welding electrodes of materials similar to Type 310 plus molybdenum for welding stainless steel Types 316, 317 and 310 parts. Joint properties: Ts, 88,000 psi; ys, 62,000 psi. Three coatings: DC lime, DC titania and AC-DC titania.

28 Cr: Arc welding electrodes of materials similar to stainless Type 446 for welding stainless steels Type 446. Joint properties: Ts, 90,000 psi; ys, 70,000 psi. A ferritic steel available in three coatings: DC lime, DC titania and AC-DC titania.

29-9: Arc welding electrodes of materials similar to stainless Type 312 for welding stainless steel Type 312 parts. Joint properties: Ts, 111,000 psi; ys, 85,000 psi. Two coatings, DC lime and AC-DC titania. For high-temperature service such as turbine blades, jet engines, etc.

29-9 Mo: Arc welding electrodes of materials similar to Type 312 stainless plus molybdenum for welding parts of stainless steel Type 312. Joint properties: Ts, 120,000 psi; ys, 94,000 psi. Two coatings: DC lime and AC-DC titania. For high-temperature service such as turbine blades, jet engines, etc.

116: Arc welding electrodes of mild steel for welding mild steel or low-alloy, high-tensile steel. Joint properties: Ts, 78,000 psi; ys, 65,000 psi. For use on poor fit-up joints and general welding. AWS E6012.

116 HV: Arc welding electrodes of mild steel for welding mild steel parts. Joint properties: Ts, 78,000 psi; ys, 69,000 psi. Similar to McKAY 116 but with deeper penetration and faster burnoff. AWS E6012.

117: Arc welding electrodes of mild steel for joining parts of mild steel. Joint properties: Ts, 75,000 psi; ys, 66,000 psi. A cellulose-coated electrode for use on ac or dc current.

711: Arc welding electrodes of mild steel for welding parts of mild steel. Joint properties: Ts, 77,000 psi; ys, 65,000 psi. Same as McKAY 11 but higher strength. AWS E7011.

715: Arc welding electrode of mild steel for welding mild steel parts. Joint properties: Ts, 77,000 psi; ys, 66,000 psi. Same as McKAY 15 but higher strength. AWS E7010.

720: Arc welding electrodes of mild steel for welding mild steel parts. Joint properties: Ts, 78,000 psi; ys, 66,000 psi. Same as McKAY 20 but higher strength. AWS E7020.

724: Mild steel arc welding electrode for joining mild steel parts. Joint properties: Ts, 81,000 psi; ys, 72,000 psi; AWS E7013.

N-155: Arc welding electrodes of complex Cr, Ni, Mo, Co, W, Fe alloy. For welding stainless steels of Type N-155. For high-temperature service such as is encountered by turbine and jet engine parts.

Stainless 20: Cr 19, Ni 28, Mo 2, Cu 3.5, Cb 0.8. Arc welding electrodes for joining parts of Carpenter stainless No. 20. Joint properties: Ts, 82,000 psi; ys, 64,000 psi. DC lime coating only.

MD (Metal powders)—Metals Disintegrating Co. Inc., Elizabeth B, N. J.

Alloy aluminum, brass, bronze, cadmium, copper, lead, manganese, nickel, silver, solder, tin, and zinc metal powders of compositions impossible to obtain by conventional methods. For powder metallurgy fabrication, welding rod manufacture, solder paste manufacture, shot peening and cleaning, paint and ink manufacture, paper and fabric coating, and chemical uses.

MECO (Brazing rods and solders)—Modern Engineering Co. Inc., St. Louis 3, Mo.

No. 24: Bronze rods for brazing steel, cast iron and bronze.

No. 1: Aluminum solder.

No. 3: Cast iron solder.

MECOBOARD (Thermosetting plastics)—Continental-Diamond Fibre Co., Newark 23, Del.

Nylon fabric base; phenolic; thermosetting. Sheets, rods, and tubes. Abrasion resistance, medium; max cont serv temp, 250 F; flex str, 11,000 psi (ASTM D-229-42); dielectric str, 370 (volts per mil inst); ts, 6,700 psi; comp str, 48,000 psi; impact str (Izod), 5.5 ft-lb; moisture absorp, low; translucent; machinability, good. For electrical insulation.

MEEHANITE METAL (Sorbo-pearlitic iron) — Meehanite Metal Corp., New Rochelle, N. Y. and foundries as listed hereunder.

Contains silicon, manganese, phosphorus, sulphur and carbon, composition depending

upon mixture and physical constitution as determined by service requirements; twenty-four grades, some of which can be heat treated, and flame hardened, each having a separate and distinct combination of physical properties; available in cast form; for machinery and miscellaneous castings.

Foundries include the following: American Brake Shoe Co., Mahwah, N. J.; American Laundry Machinery Co., Rochester, N. Y.; Atlas Foundry Co., Detroit; Banner Iron Works, St. Louis; Barnett Foundry & Machine Co., Irvington, N. J., E. W. Bliss Co., Toledo, O. and Hastings, Mich.; Builders Iron Foundry Inc., Providence, R. I.; Cincinnati Milling Machine Co., Cincinnati; Continental Gin Co., Birmingham, Ala.; Cooper Bessemer Corp., Grove City, Pa. and Mt. Vernon, O.; Crawford & Doherty Foundry Co., Portland, Oreg.; M. H. Detrick Co., Newark, N. J.; The Elliott Co., Jeannette, Pa.; Farrel-Birmingham Co. Inc., Ansonia, Conn.; Florence Pipe Foundry & Machine Co., Florence, N. J.; Fulton Foundry & Machine Co. Inc., Cleveland; General Electric Co., Ontario, Calif.; General Foundry & Mfg. Co., Flint, Mich.; Greenlee Foundry Co., Chicago; Hamilton Foundry & Machine Co., Hamilton, O.; Johnstone Foundries Inc., Grove City, Pa.; Kanawha Mfg. Co., Charleston, W. Va.; Koehring Co., Milwaukee; Lincoln Foundry Corp., Los Angeles; E. Long Ltd., Orillia, Ont.; The Newark Stove Co., Newark, O.; Otis Elevator Co. Ltd., Hamilton, Ont., Henry Perkins Co., Bridgewater, Mass.; Pohlman Foundry Co. Inc., Buffalo, N. Y.; Prescott Co., Menominee, Mich.; Rosedale Foundry & Machine Co., Pittsburgh; Ross Meehan Foundries, Chattanooga, Tenn.; Shenango-Penn Mold Co., Dover, O.; Sonith Industries, Inc., Indianapolis, Ind.; Standard Foundry Co., Worcester, Mass.; Stearns-Roger Mfg. Co., Denver, Colo.; Traylor Engineering & Mfg. Co., Allentown, Pa.; Valley Iron Works Inc., St. Paul; Vancouver Engineering Works Ltd., Vancouver, B. C.; Vulcan Foundry Co., Oakland, Calif.; Warren Foundry & Pipe Corp., Phillipsburg, N. J.; Washington Iron Works, Seattle; Washington Machinery & Supply Co., Spokane, Wash.

MELMAC (Melamine formaldehyde plastics) — Plastics Department, American Cyanamid Co., New York 20.

1502: A cellulosic-filled, melamine formaldehyde plastics; thermosetting; granules for compression or transfer molding. Chemical resistance, good; flex strength (ASTM D650-42T), 9000-10,000 psi; dielectric str (volts per mil inst), 350-400 at room temperature; ts, 6000 psi; imp str (Izod), 0.40 ft-lb; moisture absorp, low; sp gr, 1.43. Opaque; machinability, good; coef thermal exp'n, 21-43 x 10^{-6}. Used for electrical insulation where arc resistance and track resistance are required.

1077: Alpha-cellulose filled, melamine formaldehyde thermosetting plastics for transfer or compression molding. Abrasion resistance, high; chemical resistance, good; max cont serv temp, 210 F; is nonflammable; flexibility, low; dielectric str (volts per mil inst), 310-315 at room temp; ts, 7-8000 psi; comp str, 40-45,000 psi; moisture absorp, low; translucent to opaque in all colors; shatterproof; sp gr, 1.5; machinability, good; Rock hdns, E100-110; coef thermal exp'n, 20-57 x 10^{-6}. Used for housings, lighting reflectors, tableware, etc.

3020: Melamine formaldehyde, thermosetting; particles for compression or transfer molding. Chemical resistance, high; max cont serv temp, 240 F; flex str, 14,000 psi; dielectric str, 270 (volts per mil inst); impact str (Izod), 0.68 ft-lb; white, green, blue, red, brown, black and ivory; moisture absorp, low; sp gr, 1.4; opaque. For electrical insulation where arc resistance is required (plus shock resistance).

MESH-TECH (Plywood)—Technical Ply-Woods, Chicago 1.

Consists of a thin three-ply panel, phenolic bonded, less than 1/16-in. thick. Faces are carefully chosen veneers of mahogany, walnut or maple. Core is a thin sheet of vulcanized material of high dielectric strength, tough, hard, dense, and light in weight. On completion, panels are fed through a die and perforated. For radio grills, air conditioning panels, interiors of buses, airplanes and railroad coaches where light weight is a factor.

METALINE (Bearing alloy)—R. W. Rhoades Metaline Co. Inc., Long Island City, N. Y.

Lubricating insert plugs of several diameters and lengths and in varied compositions for rendering bronze bearings and bushings oilless. Also bronze bearings, complete in which Metaline plugs are inserted, furnished as finished bearings.

METAL & THERMIT (Welding electrodes)— Metal & Thermit Corp., New York 5.

Type R: For welding mild steel. All-position, dc,, reverse polarity. Joint properties: Ts, 63-75,000 psi; elong in 2 in., 22-31%. AWS E6010.

Type A: For welding mild steel. General-purpose, ac or dc, straight or reverse polarity. Joint properties: Ts, 62-71,000 psi; elong in 2 in., 22-26%. AWS E6011.

Type U: For welding mild steel. For vertical or overhead applications and single-pass H fillet work, ac or dc. Joint properties: Ts, 74-80,000 psi; elong in 2 in., 17-25%. AWS E6013.

Type HTS: For welding mild steel. All positions, dc or ac; for high carbon, sulphur-bearing and cold-rolled steels. Joint properties: Ts, 66-73,000 psi; elong in 2 in., 28-34%. AWS E6016.

Type FHP: For welding mild steel. Downhand butts or fillets, ac or dc. Joint properties: Ts, 62-69,000 psi; elong in 2 in., 25-31%. AWS E6020.

Type MA: For welding low-alloy steels. Ac or dc, straight polarity. Joint properties: Ts, 70-78,000 psi; elong in 2 in., 22-29%. AWS E7011.

Type M: For welding low-alloy steels. Ac or dc, down-hand. Joint properties: Ts, 70-80,000 psi; elong in 2 in., 25-32%. AWS E7020.

Type 8016 Q: For welding low-alloy steels. Repair of castings and welding of nickel steels. Joint properties: Ts, 95,000 psi; elong in 2 in., 25%. AWS E8016.

Type AB-12: For manganese bronze castings, brass sheets or plates, dissimilar metals. Joint properties: Ts, 65,000 psi min; elong in 2 in., 15% min. AWS E-CuAl (A).

Type AB-16: For overlays subject to shock or impact. Joint properties: Ts, 85-97,000 psi; elong in 2 in., 10-19%. AWS E-CuAl (B).

Type AB-20: For overlays on machine parts in hard usage; for example, heavy-duty gears. Joint properties: Ts, 90-101,000 psi; elong in 2 in., 4-9%. AWS E-CuAl (C).

Type AB-25: For overlays requiring high hardness to withstand extreme wear. Joint properties: Ts, 78-86,000 psi; elong in 2 in., 0.5-1.0%. AWS E-CuAl (D).

Type AB-30: Very hard deposit with usual good bearing qualities of aluminum bronze. Joint properties: Ts, 70-73,000 psi. AWS E-CuAl (E).

SB-80: A shielded-arc silicon bronze rod for silicon bronze copper and iron base metals. Joint properties: Ts, 46,000 psi; elong in 2 in., 22%. AWS E-CuSi.

METCO-WELD H (Powdered hard-facing alloy) —Metallizing Engineering Co., Inc., Long Island City, N. Y.

A "wire" composed of a powdered hard-facing alloy extruded with a plastic binder; applied by metal spraying, subsequent fusing with a fusing torch results in a coating alloyed to the base metal which is physically and chemically identical to hard-facing the same alloy applied by other methods. Hard facing is extremely resistant to abrasion and corrosion, has high strength and exceptional resistance to oxidation.

MICABOND (Mica material) — Continental-Diamond Fibre Co., Newark 23, Del.

Built-up mica material. Sheets and tubing, for machining and forming into parts. Bonded together with shellac or synthetic resins to provide high dielectric str; heat and moisture resistant. Two types: standard for general use, and super for special applications requiring unusually high heat resistance and dielectric strength. Each type produced in number of grades for specific applications. For V-rings, washers, segments and special shapes.

MICANITE (Built-up mica) — Mica Insulator Co., Schenectady, N. Y.

Sheets, tapes and tubes of Class B and H insulation. Readily molded, cut or stamped. Used for electrical insulation on commutator rings and segments, appliance heating element patterns, slot cells, and core, coil and busbar insulation; cable and coil tapes; phase, ground and coil insulation; insulating tubes, etc.

MICARTA (Thermosetting plastics) — Westinghouse Electric Corp., Trafford, Pa.

Melamine formaldehyde base and phenol formaldehyde base. Laminated sheets, rods, and tubes. Abrasion resistance, high; chemical resistance, good up to 15% solutions; max cont serv temp, 105-130 C; flex str (ASTM D 650-42T), 10,000-27,000 psi; dielectric str 100-600 (volts per mil inst); ts, 6,000-16,000 psi; comp str, 8000-40,000 psi; in black and natural; opaque; Rock hdns, M98-122. For variety of industrial applications such as gears, cams, panels, dials, rayon spinning buckets, steel-mill bearings, etc.

MICHIANA (Heat-resisting cast alloys)—Michiana Products Corp., Michigan City, Ind.

Zorite: Ni 35, Cr 15. Properties, cast: Ts, 63,500 psi; ys, 36,500 psi; elong in 2 in., 5.2%; reduction of area, 6.1%; bhn, 168. Used for castings operating at elevated temperatures.

No. 100 Alloy: Cr 25, Ni 12. Properties, cast: Ts, 70,500 psi; ys, 40,100 psi; elong in 2 in., 14.5%; reduction of area, 15.4%; bhn, 166. Used for castings operating at elevated temperatures.

Fire Armor "B": Ni 60, Cr 13. Properties, cast: Ts, 65,800 psi; ys, 33,800 psi; elong in 2 in., 4.5%; reduction of area, 5.5%; bhn, 181. Used for castings operating at high temperatures.

MICHIGAN (Seamless tubing)—Michigan Seamless Tubing Co., South Lyon, Mich.

Cold-drawn: Of standard carbon and alloy steels and of special alloys to customers' requirements. Available in rounds, squares and special shapes. For aircraft, pressure and mechanical uses.

MICHIGAN (Welded steel tubing) — Michigan Steel Tube Products Co., Detroit 12, Mich.

Electric resistance welded steel tubing; straight or fabricated to specification. Round, square or rectangular. From ¼-in. to 4 in. diam; from 0.022 to 0.148-in. wall thickness.

MICRO-ROLD (Stainless steel sheet and strip) —Washington Steel Corp., Washington, Pa.

Precision cold rolled stainless steel sheet and strip up to 36 inches wide in Types 301, 302, 304, 321, 347 in gages from .095 to 0.004 inch.

MIDVALE (Steels) — Midvale Co., The, Nicetown, Philadelphia 40.

Forgings, weldless rings, any analysis (carbon, alloy or stainless steel), hardened and ground steel rolls, heat and corrosion resistant castings, and cast-to-shape tool steel.

MIDVALOY Hi-C Hi-Cr (Cast-to-shape tool steel)—Midvale Co., The, Nicetown, Philadelphia 40, Pa.

Sand castings. Hardness, annealed: Bhn, 210-240; hardness, hardened: Rock hdns, C59. Weldability, poor; abrasion resistance, high. Machines readily; distorts very little and is nearly immune from cracking during heat treatment. Used wherever abrasion and wear resistance is an important requirement. Used for dies, blanking, beading, cams, cutting, drawing, extrusion and knurling tools.

MILNE HOLLOW DIE STEEL (Tool steel)—A. Milne & Co., New York 14.

Straight carbon, oil hardening, and high-chrome, high-carbon air hardening steels in tubes. For use in machine parts, sleeves, bushings, collets, hollow spindles, etc.

MINIMESH (Expanded metal)—Penn Metal Co. Inc., Boston 9.

Expanded sheets of carbon steel, stainless steel, aluminum, copper, Monel metal, etc., combining maximum strength with lightness. For machine guards, ventilation around motors, shelving, racks, drying trays, grating, filters, etc. Mesh size $\frac{3}{8}$ to 1½-in.; thickness No. 22 gauge to No. 9 gauge.

MIRROPANE (Plate glass mirror) — Libbey-Owens-Ford Glass Co., Toledo, O.

Transparent mirror made of plate glass, one side coated with evaporated chromium alloy. Light transmission, 8%; reflection, 50%. Highly resistant to normal action of weathering, cleaning, handling, and glazing compounds. Good color fidelity and durability. For scientific instruments and other uses subject to investigation.

MISCO METAL (Stainless steels) — Michigan Steel Casting Co., Detroit 7, Mich.

For data on types, properties, characteristics and applications see "Stainless Steels" listing at end of this section.

M.M. (Plastic) — Sandee Manufacturing Co., Chicago 30.

Methyl methacrylate plastic rods, tubes and special shapes. Resists weak alkalies, acids, alophatic, hydrocarbons; not resistive to concentrated acids and organic solvents. Flex str, 13,000-17,000 psi; dielectric str. 450-500 (volts per mil inst); ts, 7500-10,000 psi; imp str (Izod), 0.4-0.5 ft-lb per inch of notch; all colors; moisture absorp, 0.3-0.4; sp gr, 1.18-1.20; transparent, translucent and opaque; machinability, good; coef thermal exp'n, 6-9 x 10^{-5} inch/inch/degree C. For insulator parts, bushings, etc.

MM (Steel castings) — Bonney-Floyd Co., The, Columbus 7, O.

C 0.25-0.35, Mn 1.20-1.40, Mo 0.15-0.25. Recommended heat treatment, quench at 1600 F in water; temper 500 F to 1325 F. Ts, 90,000-180,000 psi; ys 60,000-165,000 psi; elong in 2 in., 6-25%; bhn, 179-420; sp gr, 7.86; magnetic; weldability, good; abrasion resistance, medium. Used for highly stressed machine parts.

MOCCASIN (Bronze alloys)—Moccasin Bushing Co., Chattanooga, Tenn.

Various bronze alloys furnished as rough castings, solid or cored bars, unished machined bars, and plain and special bushings.

MOGUL (Babbitt)—Federal Mogul Corp., Detroit.

Mogul alloy genuine babbitt: Made from tin, antimony and copper, virtually lead free. Hard, tough alloy; high tensile strength; suitable for die-cast and hand-poured bearings. Used for high-speed automobile and aircraft engine, steel and bronze back main and connecting-rod bearings, trucks, tractors, high-speed machinery, planers, etc.

Mogul bearing metals: General all-purpose babbitt for bearings requiring toughness. Used for machinery bearings, stationary gas engines, paper mill rolling mill, rubber plant and brick machinery.

MOLEX (Arc welding electrode) — Metal & Thermit Corp., New York 5.

For low-alloy, high-strength machine parts. Weld deposit: Ts, 70-75,000 psi; ys, 57-66,000 psi; elong in 2 in., 22-31%.

Type R: Arc welding electrode for use in shipbuilding, pipe fabricating, refineries, etc. Weld deposit: Ts, 63-75,000 psi; ys, 54-61,000 psi; elong in 2 in., 22-31%.

Type S: Arc welding electrode for sheet metal fabrication in automotive work, storage tanks, railroad cars, road and farm machinery. Weld deposit: Ts, 71-75,000 psi; ys, 62-64,000 psi; elong in 2 in., 20-26%.

MOLEX (Molding plastics)—Molex Products Co., Chicago 6, Ill.

Bituminous and asbestos thermoplastics compound fabricated by injection and compression molding. Abrasion resistance, low; max cont serv temp, 186 F; dielectric str, (volts per mil inst.), 205 after immersion in water 24 hours; ts, 2000 psi; comp str, 10,000 psi; in black only; moisture absorp, very low; sp gr, 1.61; opaque; machinability, fair. For electric insulators, terminal blocks, receptacles, structural blocks, radiator valve wheels, etc.

MOLIN METAL (Aluminum-bronze alloys) — Dirilyte Co. of America Inc., Kokomo, Ind. Permanent-mold castings and forgings to specifications.

No. 2: Properties, untreated: Ts, 74,000 psi; elong in 2 in., 9%; bhn, 140-150; weldability, good; abrasion resistance, high. For welding machine fixtures, bearings, etc.

No. 2½: Properties, heat-treated: ts, 67,000 psi; elong in 2 in., 3%; bhn, 180-200; weldability, good; abrasion resistance, high. For welding machine fixtures, bearings, acid bath hooks, etc., which require higher hardness than that offered by Molin Metal No. 2.

No. 3: Properties, untreated: Ts, 50,000 psi; elong in 2 in., 4%; bhn, 200-220; weldability, fair; abrasion resistance, high. For wiping dies, die plates, welding machine fixtures, etc.

MOLYBDENUM (Alloying element) — Climax Molybdenum Co., New York 18, N. Y.

Alloying element for use in steel and iron. Imparts strength, toughness, ductility and resistance to abrasion; improves fatigue value, eliminates temper brittleness, improves mechanical properties at elevated temperatures.

MOLYBDENUM PERMALLOY (Electrical steel)—Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

Ni-Mo-Fe alloy of high permeability. Must be dry hydrogen annealed after fabrication. Finished rods or bars, coiled strip, wire, sheets. Used as a magnetic core material in special audio transformers, instruments and for magnetic shields.

MOLY-TELASTIC (Alloy cast steel) — Falk Corp., The, Milwaukee, Wis.

C 0.30-0.40, Mn 1.00-1.50, Mo 0.15-0.25. Sand castings to specification. Properties, heat-treated: Ts, 100,000-200,000 psi; ys, 70,000-160,000 psi; elong in 2 in., 25-12%; endurance limit, 45-50% of ts; bhn, annealed, 160; 200-400, heat treated. Used for gears, crusher parts, excavating equipment and similar heavy duty services.

MO-MANG (Welding electrodes) — American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

C 0.8, Mn 14.0, Mo 0.2. Bhn, 200 (work hardens up to 500 bhn). Extremely impact and abrasion resistant from —100 F to 500 F. For welding austenitic manganese steel castings and rolled shapes. Austenitic steel deposits; nonmagnetic. For build-up welding on dipper lips, hammer mill parts, dredge pump shells, stone crusher equipment, etc.

MONARCH (High-lead bronzes) — Monarch Alloys Co., Ravenna, O.

Several different grades, produced by water-chilled process. Rough bars in 2-ft lengths. Good bearing qualities and good machinability. Also produce bronze and aluminum sand castings, and metal-forming dies of Kirksite, a high zinc-base alloy.

MONEL (High nickel-copper alloys)—The International Nickel Co. Inc., New York.

Monel Wrought Forms: Ni 67.0, Cu 30.0, Fe 1.4, Mn 1.0, Si 0.1, C 0.15, S 0.01. Various tempers of rod and bar, forgings, sand, centrifugal, and precision-investment castings, cold-drawn wire, hot-rolled plate, cold-rolled sheet and strip, and seamless tubing. Property ranges: Ts, 70-170,000 psi; ys, 25-160,000 psi; elong in 2 in., 50-1%; bhn, 110-275. Corrosion resistance, high. For propeller shafts, pump shafts and rods, impellers, bolts, rivets, etc., orifice plates, tanks, electrical contact parts, springs, carburetor parts, strainers, screen filters, etc.

"R" Monel Wrought Forms: Same composition as Monel except 0.25 to 0.60 S. Rod and bar, cold-drawn wire. Range of properties: Ts, 75-115,000 psi; ys, 35-100,000 psi; elong in 2 in., 45-15%; bhn, 130-240. Corrosion resistance, high. Machinability, better than Monel. For parts requiring good corrosion and abrasion resistance combined with free-cutting qualities.

"K" Monel: Ni 66.0, Cu 29.0, Fe 0.9, Mn 0.75, Si 0.5, C 0.15, Al 2.75. Heat-treatable material resembling Monel. Rod and bar, strip forgings, sheet, seamless tubing, and wire in various forms and tempers. Nonmagnetic. Range of properties: Ts, 90-200,000 psi; ys, 40-145,000 psi; elong in 2 in., 45-2%; bhn, 140-380. Corrosion resistance, high. For marine pump shafts, wearing sleeves, oil-pump drop and seat-valves, valve disks and pump rods, ball-bearing races, balls and cones, roller chain, link studs, check-valve balls, wire springs, etc.

"KR" Monel Wrought Forms: Rod and wire only. Composition same as "K" Monel except higher carbon. Heat treatable. Better machinability than K.

Monel Castings: Ni 63.0, Cu 23.0, Fe 1.5, Mn 0.7, Si 1.6, C 0.15, S 0.015. In untreated state: Ts, 65-90,000 psi; ys, 32-40,000 psi; elong in 2 in., 45-25%; bhn, 125-150. Slightly magnetic; weldability, good; abrasion resistance, medium; max cont serv temp, 800 F (under load); corrosion resistance, high. For pump casings, impellers, filter plates, valve bodies, trim, bushings, fittings. Widely used where corrosion resistance is an important factor as in laundry, pickling, tanning, marine, chemical, oil-processing, paint and food-processing equipment.

"H" Monel Castings: Sand, centrifugal, precision-investment castings. Composition similar to Monel except Si 3.0. Ts, 90-115,000 psi; ys, 60-80,000 psi; elong in 2 in., 20-10%; bhn, 175-250 nonmagnetic; weldability, poor; abrasion resistance, medium; max cont serv temp, 800 F (under load); corrosion resistance, about same as Monel. For parts similar to those for which regular Monel is suitable, but where better abrasion and erosion resistance is required, plus higher strength, as for steam nozzles.

"S" Monel Castings: Sand, centrifugal, precision-investment castings. Composition similar to Monel except Si 4.0. Properties, heat-treated: Ts, 110-145,000 psi; ys, 80-115,000 psi; elong in 2 in., 4-1%; bhn, 300-375; nonmagnetic; weldability, poor; abrasion resistance, high; max cont serv temp, 1100 F (under load); corrosion resistance, about same as regular Monel. Parts, similar to those for which regular Monel is suitable, but where top resistance to galling and erosion are needed, as for valve seats, etc.

MONIMAX (Electrical steel)—Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

High Ni-Mo steel having good permeability at moderate flux densities. Used in low and intermediate density high-frequency cores.

MORAINE (Porous metal)—Moraine Products Div., General Motors Corp., Dayton, O.

Filtering and diffusing material, product of powder metallurgy in bronze, and other metals. Provides high flow rates, low flow resistance; used in fuel and lubricating systems, instruments, breathers, burners, separators, etc.

MORGANITE (Carbon-graphite) — Morganite, Inc., Long Island City, N. Y.

Carbon-graphite and carbon - graphite - metal mixtures. Resists corrosion by most liquids handled; max cont serv temp, 700 F; abrasion resistance, good; ts, 1500-7000 psi; comp str, 3000-39000 psi; ductility, low; sp gr, 1.5-3.1. For bearings, valves, seals, nonfriction slides, piston rings, etc.

MOSIL (Alloy tool steel) — Vanadium Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

C 0.55, Si 1.90, Mn 0.85, Cr 0.25, Mo 0.33. Rough bars or billet, finished rods or bars, wire, sheet, plate, forgings, and drill rod; for permanent-mold castings, precision casting; machining, hot and cold working, stamping, drawing and brazing. Properties, heat-treated: Rock hdns, C62-63 max; magnetic; abrasion resistance, medium. For shanks, chisels, dogs, shears, etc.

M. P. (Plastic) — Sandee Manufacturing Co., Chicago 30.

Modified polystyrene thermoplastic rods, tubes and special shapes. Soluble in aromatic and chlorinated hydrocarbons, ketones and ethers. Insoluble in weak acids, alkalies and alcohols; flex str, 6500-7500 psi (D 790-95T); ts, 6100-10,000 psi; imp str (Izod), 0.8-1.2 ft-lb per inch of notch; opaque colors; machinability, good. For electrical insulators, spacers, etc.

MR (Plastic resins) — Marco Chemicals Inc., Sewaren, N. J.

Polyester thermosetting resin in liquid form for castings and laminates. Electrical properties, heat and corrosion resistance, excellent; moisture absorp, low; machinability, good.

MRCO (Metal powders)—Metals Refining Co., Hammond, Ind.

40 RL: Cu 99.4. All passing in a 40-mesh sieve, not over 20% passing a 200-mesh screen; has apparent density of 2.5 grams per cu cm. Used in commutator brushes, chemical porous filters, catalyzers, and pressed metal compositions.

100 RXA: Cu 99.4. All passing a 100-mesh screen; not over 45% passing a 325-mesh screen; has apparent density of 2.7 grams per cu cm. Used in porous metal bearings, intricate pressed metal shapes, electrical commutator brushes, etc.

150 RXA: Cu 99.4. All passing a 150-mesh sieve, not over 75% passing a 325-mesh sieve; has apparent density of 2.75 grams per cu cm. For same applications as 100 RXA.

200 RL: Cu 99.4. All passing a 200-mesh sieve, and not less than 85% passing a 325-mesh sieve. Used in chemical equipment, special commutator brushes, porous bearing compositions; also has advantages for copper brazing and coating welding rods.

500 RL: Cu 99.4. All passing a 325-mesh sieve, and substantially all particles are less than 15 microns in diam. For use where extremely fine particle size is desired, in brazing and coating, as clutch facings, etc.

I-100: Fe 96 min. All passing a 100-mesh sieve; and 25-45% passing 325-mesh sieve; has apparent density of about 1.8-2.0 grams per cu cm. For pressed parts such as clutch facings, gears, filters, etc.

I-120: Fe 96 min. All passing 100-mesh sieve and 30-50% passing 325 mesh. Has apparent density of 2.3-2.5 grams per cu cm. Same uses as I-100.

I-147: Fe 96.5 min. All passing 40 mesh sieve and 10-20% passing a 325-mesh sieve. Has apparent density of 1.8-2.0 grams per cu cm. Same uses as I-100.

I-247: Fe 97 min. Apparent density 2.65-2.85 grams per cu cm; all passing a 40-mesh sieve with 10-20% passing 325-mesh sieve; hydrogen-annealed for pressed ferrous metal compositions and electrical parts requiring high priority iron.

M & T (Welding electrodes) — Metal & Thermit Corp., New York 5.

Nickel-manganese: Ac or dc. Deposit has high tensile strength and ductility. For hard surfacing and building up. Bhn of deposit, 170-190; work-hardens to 450-500.

Moly-manganese: Ac or dc. For building up high-manganese and carbon steels. Bhn of deposit, 190-210; work-hardens to 450-500.

Tool steel (A): Ac or dc. For hard surfacing of dies; deposit can be forged. Hardness of deposit, Rock C45-60 (depends on heat treatment).

Tool steel (B): Ac or dc. For surfacing carbon steel, for tools and jigs; deposits can be forged. Bhn of deposit, 575-675, depending on dilution from base metal.

Type 19-9: Dc only. For welding Types 310, 302, 304, 305 and 308 stainless steels. Weld

properties: Ts, 84,000 psi; elong in 2 in., 47%.

Type 19-9 Cb: Dc only. For welding Types 321 and 347 stainless steels. Weld properties: Ts, 95,500 psi; elong in 2 in., 39%.

Type 19-9-W Mo: Dc only.

25-20 Type 310: For welding Type 310 stainless steel. Weld properties: Ts, 85,300 psi; elong in 2 in., 42%

25-20 Cb: Dc only. For welding Type 310 stainless steel. Weld properties: Ts, 90,-600 psi; elong in 2 in., 28.5%.

25-12 Type 309: Ac or dc. For welding Type 309 stainless steel. Weld properties: Ts, 82,600 psi; elong in 2 in., 42%.

18-8 Mo: For welding Type 316 stainless steel. Weld properties: Ts, 78,000 psi; elong in 2 in., 45%.

18-8 Mo (Type 317): For welding Type 317 stainless steel. Weld properties: Ts, 98,750 psi; elong in 2 in., 39%.

4-6 Cr: For welding Types 501 and 502 stainless steels. Weld properties: Ts, 143,175 psi; elong in 2 in., 30%.

28 Cr: Dc only. For welding Type 446 stainless steel.

Sulcoat: Dc, straight polarity. Cut lengths and coils: Weld properties: Ts, 45-55,000 psi; elong in 2 in., 4-8%. AWS E4510.

Smoothcoat: Dc, straight polarity. Cut lengths. Weld properties: Ts, 55,000 psi min; elong in 2 in., 4-8%. AWS E4520.

Autocoat: Dc, straight polarity. Coils. Weld properties: Ts, 55,000 psi min; elong in 2 in., 8-10%. AWS E4520.

Autocoat K: Dc, straight polarity. Coils. Weld properties: Ts 55,000 psi; elong in 2 in., 8-10%. AWS E4520.

Type E-43: Dc reverse polarity. For aluminum plate shapes and castings. Weld properties: Ts, 14,000 psi min.

No. 1 Low Carbon: For welding low-carbon steel; bead or puddle deposit.

No. 4 High Carbon: For building up and hard surfacing.

No. 2 Mild Steel: Copper coated. For steel parts.

No. 3 High Strength: Used where high tensile strength and ductility are needed.

No. 5 3½% Nickel: For plain carbon or low-alloy steel welding. Weld ts, 75,000 psi max.

Low Fuming Bronze: For steel, cast iron and wrought iron; low melt pt (1600 F).

MUELLER 600 (Bearing metal)—Mueller Brass Co., Port Huron, Mich.

Cu 56-60, Pb 0.5 max, Mn 1.25-3.5, Al 0.5-2, Si 0.5-1.2, Fe 0.6 max, and Zn, remainder. Sold as extruded and drawn, and rods and bars, and as die forgings from rod. Ts, 70-85,000 psi; ys, (1½% extension) 45-50,000; elong in 2 in., 20 to 10% for die forgings. Sp gr, 8.071; conductivity about 12% of copper; nonmagnetic; corrosive resistance against sea water, good. Used as low speed heavily loaded bearings as it withstands damage from lubricants carrying considerable sulphur compounds. Also used for high-speed bearings on hardened mating surfaces, cam faces and machine parts subject to wear, such as pump rods and shafts, and forged connecting rods for high-speed.

MULTIMET ALLOYS (Iron-base alloys) — Haynes Stellite Div., Union Carbide and Carbon Corp., Ind.

Low carbon wrought: C 0.20 max, Cr 20.0-22.5, Ni 19.0-21.0, Mo 2.50-3.50, Cb 0.75-1.25, W 2.00-3.00, Co 18.5-21.0, N 0.10-0.20, Fe balance. Finished rods or bars, tubing, wire, sheet, plate, welding rod and forgings. Properties, heat-treated: Ts (sheet), 121,000 psi; ys (sheet), 64,000 psi; elong in 2 in. (hot rolled sheet), 48%; Rock hdns, B 90; sp gr, 8.27; nonmagnetic; machinability, good; weldability, good; resists oxidation at elevated temperatures; max cont serv temp, 2100 F; abrasion resistance, medium. Especially recommended for high-strength, high-temperature service.

Low carbon cast: C 0.20 max, Cr 20.0-22.5, Ni 19.0-21.0, Mo 2.50-3.50, Cb 0.75-1.25, W 2.00-3.00, Co 18.5-21.0, N 0.10-0.20, Fe balance. Tubing, sand castings, precision castings and welding rod. Properties, heat-treated (¼ in. diam precision-cast specimens with 1-in. gage length): Ts, 83,000 psi; ys, 55,200 psi; elong in 2 in., 11.8%; Rock hdns, B 90; sp gr, 8.20; nonmagnetic; machinability, fair; weldability, fair; resists corrosion caused by oxidation at elevated temperatures; max cont serv temp, 2100 F; abrasion resistance, medium; for medium high-strength, high-temperature service castings.

MULTIPLATE (Laminated bullet-resisting plate glass)—Pittsburgh Plate Glass Co., Pittsburgh 19.

Multiple laminated plate glass, Vinyl plastic binder; in cut sizes and shaped. Corrosion and abrasion resistance, high; shatterproof; transparent; highly polished. For protection against high velocity missiles.

MULTI-WEAVE (Special composite materials)—General Electric Co., Electronics Dept., Syracuse, N. Y.

Made by inter-weaving strands, strips, etc., of metals, plastics, wood, rubber, fabrics, etc., or combinations thereof. Produced to specification. For ventilating grilles, decorative panels, gratings, bulkheads, air-conditioning grilles, guards, refrigerator trays, cigarette cases, display fixtures, etc.

MUMETAL (Electrical steel)—Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

High permeability Ni-Cu-Cr-Fe alloy, that must be high-temperature, dry-hydrogen annealed after fabrication. Sheet, strip, bar and laminations, also shields. For special electrical instruments and transformers requiring highest performance.

MYCALEX (Glass-bonded mica)—Mycalex Corp. of America, Clifton, N. J.

Sheets ⅛ to 1 in. thick, 14 x 18 in.; rods 18 in. long, ¼ to 1 in. diameter. Abrasion resistance, medium; unaffected by most liquids except acid solutions; max cont serv temp, 750 F; nonflammable; flexibility, low; dielectric str, 400 (volts per mil inst.); ts, 6000 psi; comp str, 35,000 psi; trans str, 15,000 psi; moisture absorp, 0; in gray and brown; sp gr, 3; opaque; machinability, good; bhn, 50; coef thermal exp'n 101 x 10^{-7} in./in./°C. For low-loss high-frequency insulators, terminal plates, precision moldings, arc and oil resistant parts.

NA, NA-1, NA-2 (Alloy steel castings) — National Alloy Steel Division, Blaw-Knox Co., Blaw Knox, Pa.

Alloy steels having varying percentages of nickel and chromium.

NACO (Cast steel)—National Malleable and Steel Castings Co., Cleveland 6, O.

Medium-manganese cast steel for special draft gears and yokes, cast chain (steam shovel, drag line, marine railway and integral stud-link anchor chains), and other industrial castings.

NATIONAL (Carbon or graphite) — National Carbon Div., Union Carbide & Carbon Corp., New York 17.

Molded, extruded or machined into practically any shape. Resistance to most acids, alkalies and solvents, high; coef thermal exp'n, low; resists thermal shock. Electrical conductivity, good. In graphitic form carbon possesses excellent lubricating properties and good thermal conductivity. Used for bearings, packings, electric current conductors, structural members and linings in the chemical and metallurgical industries. Available in blocks, brick, tile, beams, slabs, cylinders, and tubes.

NATIONAL (Porous carbon)—National Carbon Div., Union Carbide & Carbon Corp., New York 17.

Available in a variety of standard and special elements in several pore size grades. Elements include open and blind-end tubes, rods up to 36 in. in length and 6⅝ in. in diam., plates with maximum dimensions of 12 x 12 x 1½ in., and blocks 14 x 14 x 9 in. Easily machined and fabricated into shapes; resistant to acids and alkalies; not subject to fracture and spalling from thermal shock. For use in filtration of corrosive liquids and gases and in conditions where thermal shock may be expected in chemical and process industries.

NATIONAL (Porous graphite)—National Carbon Div., Union Carbide & Carbon Corp., New York 17.

Standard and special shapes including cylinders, blocks, open or blind-end tubes, and rods. Uniform high porosity and small pore size; easily machined and fabricated into practically any shape; resistant to acids and alkalies; not subject to fracture and spalling from thermal shock; electrical conductivity, high. For filtration, gas dispersion, etc.

NATIONAL (Graphitic steel)—National Malleable & Steel Castings Co., Cleveland.

High-strength steel funished in castings. Abrasion resistance, medium; ts, 75,000 psi min; can be flame hardened; bhn, 200 avg. For automotive and other medium-size castings requiring high strength and good machinability.

NATIONAL (Metals) — National Bearing Div., American Brake Shoe Co., St. Louis 10.

Various nonferrous centrifugal and precision castings, babbitt metals and precision bearings. Castings produced to specifications.

397 Babbitt: Bars, Ts, 9500-10,000 psi; used primarily for bearing linings.

Diesel Engine Babbitt: Tin-base. Bars. Ts, 11,000 psi at 1% deformation; used primarily for bearing linings.

NATIONAL (Powder metal)—National Molded Products Inc., St. Marys, Pa.

Cu 90, Sn 10. Powder. Nonmagnetic; corrosion-resistant; max cont serv temp, 400 F; abrasion-resistant. For bearings or intricate part.

NATIONAL FIBRE—National Vulcanized Fibre Co., Wilmington, Del.

Converted cotton cellulose, chemically pure, tough horn-like material. Hard or flexible form in sheets, rolls, tubes, rods and fabricated shapes. Dielectric and mechanical str, high; resistant to abrasion and shock; easily formed and machined; light in weight. Used for gears, valve disks, gaskets, washers, bobbin heads and electrical insulation.

NATIONAL-STANDARD (Wire, braided wire and tape)—National-Standard Co., Niles, Mich.

Wire braids flat and tubular of steel or other metals.

Tapes and specialized wire products for tire beads, steam hose armor, reinforcement for oil well drilling hose, braided covering for flexible tubing.

Standard wire for reinforcing flat and V-belts.

Braided covering for electrical cables.

Drawn wire in small sizes down to 0.002-in. of steel, aluminum, brass, Monel, nickel silver, stainless steel, phosphor bronze and other alloys.

NATIONAL SWITCH INSULATION — National Vulcanized Fibre Co., Wilmington, Del.

Combination laminated. Bakelite core with vulcanized fiber surfaces. Sheets and fabricated shapes. High tracking (arc) resistance combined with rigidity and minimum warpage; dielectric and mechanical str, high; moisture absorp, low; easily stamped and fabricated. Used in switches to support and insulate current-carrying parts.

N-A-X (High-strength low-alloy steel)—Great Lakes Steel Corp., Div. of National Steel Corp., Ecorse, Mich.

9100 Series: C 0.1-0.7, Mn 0.6-0.75, P 0.040 max, S 0.05 max, Si 0.6-0.9, Cr 0.5-0.65, Mo 0.1-0.2, and Zr 0.05-0.15. Rough bars or billets, finished rods or bars, strips (coiled), sheets and plates, for forging, stamping, turning, boring, etc. Recommended heat treatment: Quench and draw—carburizing grades treated by regular conventional methods.

High tensile: C 0.12, Mn 0.70, Si 0.80, Cr 0.60, S 0.030, P 0.025, and Zr 0.10. Rough bars or billets, finished rods or bars, strips (coiled), tubing, wire, sheets and plates for stamping and welding. No subsequent treatment needed after hot working. Good stability and ductility permit it to be cold-formed. Impact resistance, good; fatigue resistance, high; welding properties, good. For machine parts where high torsional properties, high tensile strength and resistance to fatigue and notch impact at normal and subzero temperatures are required.

NEILLITE (Phenolic plastics)—Watertown Mfg. Co.; Watertown, Conn.

Thermosetting material: Powder form and granules for molding into parts; abrasion resistance, medium; resists corrosion caused by weak acid and alkali; dielectric str, 375-400 (volts per mil inst); ts, 5500-7500 psi; comp str, 22,200-32,600 psi; moisture absorp, low; nonflammable; in colors, shatterproof. For switch cases, spacers, gears, cams; knobs, etc.

NELOY and NELOY-MOLY (Cast steels)—National Erie Corp., Erie, Pa.

Medium-manganese cast steel and medium-manganese plus molybdenum cast steels. Rough-finished, machined or flame hardened. High strength and hardness due to combination of alloying and special hardening. High abrasion resistance. For various applications in rolling mills and steel works equipment, overhead traveling cranes, power shovels, drag lines, etc.

NEMALOY (Aluminum alloy castings)—Alloy Precision Castings Co., Cleveland 14.

No. 9; Si 4.50-6.00, low impurities, Al balance. Sand or permanent-mold castings. Properties, untreated: Ts 19,000 psi; comp str, 10,000 psi; ys, 9000 psi; elong in 2 in., 5.0% impact str (Charpy), 1.0 ft-lb; endurance limit (completely reversed bending), 6500 psi; bhn, 40; sp gr, 2.70; nonmagnetic; weldability, good; max cont serv temp, 250 F. For various corrosion resisting parts.

No. 50: Cu 8.0, Fe 1.0, Si 1.2, Al balance. Sand and permanent-mold castings. Properties, untreated: Ts, 23,000 psi; comp str, 14,000 psi; ys, 14,000 psi; elong in 2 in., 2.0%; impact str (Charpy), 0.6 ft-lb;

endurance limit (completely reversed bending), 8000 psi; bhn, 65; sp gr, 2.83; max cont serv temp, 250 F; nonmagnetic. For general purpose castings.

No. 54: Cu 4.0, Mg 1.5, Ni 2.0, Al balance. Sand and permanent-mold castings. Properties, heat-treated: Ts, 37,000 psi; comp str, 47,000 psi; ys, 32,000 psi; sp gr, 2.77; nonmagnetic; weldability, good; max cont serv temp, 350 F; abrasion resistance, high. For parts subjected to elevated temperatures.

No. 64: Si 7.0, Mg 0.3, Al balance. Sand and permanent-mold castings. Properties, heat-treated: Ts, 33,000 psi; comp str, 22,000 psi; ys, 24,000 psi; elong in 2 in., 4.0; sp gr, 2.68; nonmagnetic; weldability, good; abrasion resistance, medium; max cont serv temp, 300 F. For intricate parts requiring high strength.

No. 105: Cu 4.0, Al balance. Sand castings Properties heat-treated: Ts, 36,000 psi; comp str, 25,000 psi; ys, 24,000 psi; elong in 2 in., 5.0; impact str (Charpy), 1.8 ft-lb; sp gr, 2.78; nonmagnetic; weldability, good; max cont serv temp, 300 F. For castings where design is not intricate and high strength is needed.

NEOPRENE (Chloroprene synthetic rubber)—E. I. du Pont De Nemours & Co., Inc., Rubber Chemicals Div., Wilmington 98, Del.

For hose, wire, cable, sheets, tank lining, gaskets, packing, tubing, belting, diaphragms, industrial truck tires and molded goods; as binder for cork and asbestos; impregnant for coat canvas, duck or other fabrics. Strength, abrasion resistance, resilience and elasticity of rubber; good resistance to deterioration from contact with oils, greases, gasoline, heat, chemicals, sunlight and ozone; will not support combustion; moisture absorption, low; ts, 4000 psi; in colors. For machine applications where rubber characteristics are required but where product is to be subjected to deteriorating influences.

NETCO (Plastics)—New England Tape Co. Inc., Hudson, Mass.

Thermoplastics such as polyvinyl, polyethylene, nylon, silicones, cellulosics, etc., in sheet, strip, tubes and fluid. For molding, stamping and extruding. Abrasion resistance, medium; chemical resistance, excellent; max cont serv temp, 220 F; nonflammable; flexibility, high; dielectric str, 750 (volts per mil inst); ts, 2000 psi; elong, 350%; moisture absorp, very low; variety of colors; shatterproof; sp gr (Polyvinyls), 1.22 (polyethylene), 0.92; transparent, translucent, opaque; machinability, poor; hardness, 30-100 Shore A; coef thermal exp'n, 7 to 25 $\times$ 10^{-5}. Recommended for oil-resistant tubing, hose covering, conduit covering, etc.

NEVAMAR (Thermosetting plastic sheets) — The National Plastic Products., Odenton, Md.

Melamine formaldehyde and phenol formaldehyde plastic sheets produced by high-pressure laminating. Abrasion resistance, high; chemical resistance, good; opaque. Nonporous, stain resistant, heat resistant, mar resistant.

NEW JERSEY ZINC (Brass, bronze, copper, nickel, silver, and zinc powder metals)—The Jersey Zinc Co., New York.

Brass Powders: All common brasses in powder metal. Ts, 29-35,000 psi; comp str, 31-43,000 psi; ys, 8500-18,800 psi; elong in 2 in., 11-50%; impact str (Charpy) 11-27 ft lb; bhn, 35-51.

Bronze Powders: Both spherical and irregular; for brazing, spraying and compacting.

Nickel Silver Powder: Cu 64, Ni 18, Zn 18. Ts, 44,000 psi; elong in 2 in., 10%.

Spherical Copper Powder: Resists corrosion caused by oils and lubricants. For filters.

Zinc Powder: For spraying, chemical reactions, etc.

NEY-ORO-G (Gold-platinum-silver-copper alloy)—The J. M. Ney Co., Hartford, Conn.

In wires, sheets, coil strips and plates. For stamping, turning, boring, welding and soldering. Properties, heat-treated: Ts, 160,000 psi; ys, 154,000 psi; elong, 6%; impact resistance, high; bhn, 280; non-magnetic; weldability, good; abrasion resistance, medium. For pivots, small bearings, springs and electrical contacts.

NICHROME-NICHROME V (High nickel-chromium alloy)—Driver-Harris Co., Harrison, N. J.

Ni 60, Cr 16, Fe balance, and Ni 80, Cr 20, respectively. High-temperature heat-resistant and electrical-resistant. Heating element material for domestic electrical appliances, electrical furnaces, ranges, also misc. elec. resistors. Castings for high-temperature furnace parts; also sheet, tubes, rod, strip and wire.

NICKALLOY (Arc welding rod)—McKay Co., The, Pittsburgh 22, Pa.

Pure nickel arc welding electrodes for joining cast iron parts. Joints have same strength as cast iron. For machinable welds in cast iron.

NICKEL—International Nickel Co. Inc., New York.

Nickel: Ni 99.4, Cu 0.1, Fe 0.15, Mn 0.25; Si 0.05, C 0.05, S 0.005. Rustproof, corrosion-resistant. For chemical, radio and electronics parts.

Low Carbon Nickel: Carbon 0.02 max; otherwise similar in chemical composition to nickel. Especially suitable in contact with fused caustic and certain fused salts and for spinning.

D Nickel: Ni 95.2, Cu 0.05, Fe 0.15, Mn 4.5, Si 0.05, C 0.1, S 0.005. A metal similar to nickel but affording superior mechanical properties and resistance to mildly sulfidizing atmospheric attack at elevated temperatures; corrosion and heat-resistant; for electrical uses.

Duranickel: Ni 93.7, Cu 0.05, Fe 0.35, Mn 0.3, Si 0.5, C 0.17, S 0.005, Al 4.4. Heat-treatable material resembling nickel except for its higher mechanical properties which are comparable to those of oil-tempered spring steel. Corrosion resistant. For products requiring high properties with corrosion resistance. For plastic dies.

Nickel Castings: Sand, centrifugal, precision-investment. Untreated: Ts, 45-60,000 psi; ys 20-30,000 psi; elong in 2 in., 30-15%; bhn, 85-125; magnetic; weldability, poor; abrasion, resistance, medium; corrosion resistance, good. For chemical and food-processing equipment parts.

NICKEL-ARC (Welding electrodes)—Alloy Rods Co., York, Pa.

Welding electrodes for welding cast iron.

NICKELOID (Nickel bonded to zinc)—American Nickeloid Co., Peru, Ill.

Zinc serves as rustproof, flexible and inexpensive white metal base. Available in variety of brilliant finishes and patterns, as sheets, flat strips and coiled strip for continuous feed automatic presses. Can be supplied with quick removable, gum-adhered paper covering, permitting drawing and forming without marring prefinish.

NI CLAD (Nickel clad copper rod and wire)—Alloy Metal Wire Co., Inc., Prospect Park, Pa.

Nickel clad copper wire, 34% cross sectional area in nickel shell covering, balance is copper. Finished rods or bars and wire. Properties, cold worked: Ts, 80-90,000 psi; ys 20-30,000 psi; elong in 2 in., 10-29%; Rock hdns, B 80-90; sp gr, 9; magnetic; weldability, good; max cont serv temp, 1000 F; abrasion resistance, medium.

NICLOY (Steel tubes)—The Babcock & Wilcox Tube Co., Beaver Falls, Pa.

Nicloy 3½: C 0.20 max, Ni, 3.25-9.75. High strength alloy for corrosion-resisting services particularly in alkaline media in chemical processing. Excellent low-temperature properties for service in oil dewaxing, refrigeration; for service to —320 F.

Nicloy 5: C 0.14 max, Ni 4.75-5.25. High strength alloy for corrosion-resisting services particularly in alkaline media in chemical processing. Excellent low-temperature properties for service in oil dewaxing, refrigeration; for service to —320 F.

Nicloy 9: C 0.12 max, Ni 8.00-10.00. High strength alloy for corrosion-resisting services particularly in alkaline media in chemical processing. Excellent low-temperature properties for service in oil dewaxing, refrigeration; for service to —320 F.

NICROMOL (Welding electrodes) — Erickson Electronic Sales Co., Rockford, Ill.

SAE 4130 alloy, Cr-Mo. Rods 3/32, ⅛ and 5/32-in. diameter; coated with flux containing titanium dioxide. For welding aircraft frames, motor supports, tractors and similar steel and cast-iron parts.

NICUITE (Bearing nickel-bronze)—A. W. Cadman Mfg. Co., Pittsburgh.

Nickel-bronze: Sn 10, Ni 3.5, Zn 2.5, trace of P, Cu balance. Comp str, high. For bearings operating at slow or medium speeds under extreme pressures.

NI-HARD (Alloy iron castings) — Jeffrey Mfg. Co., The, Columbus 16, O.

Bhn (stress relieved), 578-650; abrasion resistance, high. For extremely wear-resistant parts.

NI-HARD (Welding rods and electrodes) — American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

C 3.5, Ni 4.5, Cr 1.5. Bhn, 600-700. Abrasion resistant up to 600 F. For hardfacing only; martensitic iron deposits; magnetic; for hard surfacing parts subject to extreme abrasion and medium impact.

NI HARD (Martensitic nickel cast iron)—International Nickel Co. Inc., New York.

Type 1 Regular Sand Cast: Total C 3-3.6, Si 0.40-0.60, Mn 0.40-0.60, S 0.15 max, P 0.40 max, Ni 4.25-4.75, Cr 1.40-2.50. Ts 40-50,000 psi; bhn, 550-650; magnetic; weldability, poor; abrasion resistance, very high. For parts such as grinding balls, ball and roll mill liners, pump parts, pug mill knives and other abrasion-resistant parts of mining, power, cement, ceramic, paint, coal, coke, and foundry equipment.

Type 1 Regular Chill Cast: Composition essentially same as above. Ts, 50-60,000 psi; bhn, 600-725; magnetic; weldability, poor; abrasion resistance, very high. For same type parts for which Type 1 Regular Sand Cast is suitable.

Type 2, High-Strength, Sand Cast: Total C 2.90 max, Si 0.50-0.80, Mn 0.40-0.60, S 0.15 max, P 0.40 max, Ni 4.25-4.75, Cr 1.40-2.50. Ts, 45-55,000 psi; bhn, 525-625; magnetic; weldability, poor; abrasion resistance, very high. Parts same as for the Regular Sand Cast Type, but for greater strength and toughness.

Type 2, High-Strength Chill Cast: Composition essentially same as Type 2, Sand Cast: Ts, 60-75,000 psi; bhn, 575-675; magnetic; weldability, poor; abrasion resistance, very high. For parts same as those for which Regular Ni Hard is suitable, but where greater strength and toughness are required.

NIKOH (Steel, tube, pipe and conduit)—Nikoh Tube Co., Chicago 32.

Mild steel of SAE 1010 and 1025 analyses: Tubing and pipe. Machinability and weldability, good. Suitable for bending, flanging, expanding, etc.

NIKRO M (Alloy tool steel)—Vanadium Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

C 0.70, Mn 0.55, Si 0.30, Cr 0.85, Ni 1.40, and Mo 0.40. Rough bars or billets, finished rods or bars, wire, sheet, plate, forgings and drill rods, for machining, hot and cold working, stamping, drawing, brazing and forging. Rock hdns, C62 max; magnetic; abrasion resistance, medium. For spindles, etc.

NIKROME "M" (Heat treated alloy steel)—Joseph T. Ryerson & Son Inc., Cleveland, O.

Cr-Ni-Mo alloy steel. Hot rolled rounds 4½ to 8 in. inclusive. Properties: Ts, 110,000 psi; ys, 90,000 psi; elong in 2 in., 16%; reduction of area, 47%; bhn, 235-302; machinability, good. For heavy duty axles, shafts, gears, pinions, lead screws, boring bars, spline shafts, high-temperature, high-pressure studs and bolts, etc.

NILVAR (Low-expansion nickel steel)—Driver Harris Co., Harrison, N. J.

A 36% Ni steel having the lowest coefficient of expansion to 392 F of any alloy. Used for thermostatic controls in heating apparatus such as electric ovens, laboratory ovens, gas ovens, oil burners, and house heating apparatus.

NI-RESIST (Austenitic nickel cast iron)—International Nickel Co. Inc., New York.

Type 1: Total C 3.00 max, Si 1-2.5, Mn 1-1.5, Ni 13.5-17.5, Cu 5.5-7.5, Cr 1.75-2.5. Properties, as-cast, Ts 25-30,000 psi; bhn, 130-160; nonmagnetic, weldability, fair; abrasion resistance, medium; max cont serv temp, 1300 F; good corrosion resistance. For pipes, pump parts, heat exchangers, etc., where corrosion resistance, elevated-temperature resistance, or high electrical resistance is required.

Type 2: Total C 3.00 max, Si 1-2.5, Mn 0.80-1.5, Ni 18-22, Cu 0.50 max, Cr 1.75-2.5. Properties, as-cast: Ts, 25-30,000 psi; bhn, 130-160. Possesses same properties and is used for same applications as Type 1.

Type 3: Total C 2.75 max, Si 1-2, Mn 0.40-0.80, Ni 28-32, Cu 0.50 max, Cr 2.5-3.5. Ts, 25-35,000 psi; bhn, 120-150; magnetic; weldability, fair; max cont serv temp, 1300 F. For corrosive applications or moderately high-temperature applications involving severe thermal gradients.

Type 4: Total C 2.60 max, Si 5.0-6.0. Mn 0.40-0.80, Ni 29-32, Cu 0.50 max, Cr 4.5-5.5. Ts, 25-35,000 psi; bhn, 150-180; slightly magnetic; weldability, fair; abrasion resistance, medium; max cont serv temp, 1500 F. For food processing equipment where stain resistance is desired.

Type 5 (Minovar Iron): Total C 2.40 max, Si 1-2, Mn 0.40-0.80, Ni 34-36, Cu 0.50 max, Cr 0.10 max. Ts, 20-25,000 psi; bhn, 100-125; magnetic; weldability, fair; for machine tool gages, scientific and optical instruments, glass molds, paper dies and equipment where low thermal coef of exp'n is required.

NI-ROD (Welding electrode) — International Nickel Co. Inc., The, New York 5, N. Y.

Flux-coated welding electrode for welding cast iron to produce machinable welds. Joint properties: Ts, 40,000 psi; ys, 30,000 psi; bhn, 170.

NI-ROD "55" (Welding electrode)—International Nickel Co. Inc., The, New York 5, N. Y.

Flux coated electrode for high phosphorous cast irons to produce machinable welds. Joint properties similar to Ni-Rod.

NI-SPAN (Constant-modulus alloy) — International Nickel Co., Inc., New York.

C: Ni 41-43, Ti 2.1-2.5, Cr 5.0-5.8, C 0.06 max, Mn 0.8 max, Si 1.0 max, Al 0.30-0.80, P 0.04 max, S 0.04 max, Fe balance. Rods and bars, straight and coiled strip, and wire. Ts, 90-200,000 psi; ys, 35-180,000 psi; elong in 2 in., 40-7%; bhn, 145-395; slightly magnetic; weldability, good. A constant-modulus alloy for springs used in accurate scales, tuning forks, bourdon tubes, diaphragms for altimeters, strain gages.

NI-SPAN C (Ti-Cr-Ni alloy)—H. A. Wilson Co., Newark 5, N. J.

A Ti-Cr-Ni alloy having a constant modulus, adjustable through heat treatment.

NI-TENSYLLIRON (Nickel alloy cast iron)—International Nickel Co., Inc., New York.

Ni 1-6, total C 2.5-3.15, Si 1.2-2.75, Mn 0.5-0.9. Ts, 40-100,000 psi; bhn 220-350; magnetic; weldability, fair; wear resistance, good. High-strength cast iron for machine tool castings, diesel engine housings, crankshafts, dies, cylinder blocks, pistons, etc.

NITRALLOY (Nitriding steel)—Nitralloy Corp., New York.

Controls nitriding process and licenses under which alloy is produced. A Cr-Mo-Al steel capable of developing extreme hardness through nitriding. For cams and camshafts, gears, pump parts, splined shafts, cylinder liners, etc. Licensees include Allegheny Ludlum Steel Corp., Firth-Sterling Steel Co., Vanadium Alloys Steel Co., Copperweld Steel Co., Atlas Steels Ltd., The Babcock & Wilcox Tube Co. Joseph T. Ryerson & Sons Inc., and The Earle M. Jorgensen Co.

NITRON (Cellulose nitrate plastics)—Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Thermoplastic sheets, or laminates for machining, molding, stamping, swedging or blowing (steam) into parts. Corrosion resistant; translucent; in colors; flexible; dielectric str, 600-1200 volts per mil; ts, 5000-10,000 psi; moisture absorp, low. For sight glasses, safety handles and structural models for strain study.

NITTANY (Free cutting brass rod)—Titan Metal Mfg. Co., Bellefonte, Pa.

Cu 61, Pb 3, Zn balance. Finished rods and bars. Properties, unheat treated; Ts, 58,-000 psi; elong in 2 in., 40%; Rock hdns, B 65. For screw machine parts.

NIXON C/A (Cellulose acetate plastics)—Nixon Nitration Works, Nixon, N. J.

Sheets, rods, tubes and granules for injection and compression molding and extruding. Abrasion resistance, high; soluble in ketones and esters, slightly soluble in alcohol, little affected by hydrocarbons. Max cont serv temp, 160 F; flex str, 4-15,000 psi (ASTM D 650-42T); dielectric str, 290-400 (volts per mil inst); ts, 4-11,000 psi; comp str, 10-30,000 psi; impact str (Charpy), 0.25-0.35 ft lb, and 1.0-4.2 ft lb (Izod); in colors; moisture absorp, low; sp gr, 1.27-1.56.

NIXON C/A/B (Cellulose acetate butyrate)—Nixon Nitration Works, Nixon, N. J.

Thermoplastic: Sheets, rods and tubes. Properties: Ts, 3-5,000 psi; flex str, 3.5-6,000 psi; imp str, 3.6-5.6; dielectric str, 250-400 (volts per mil inst); abrasion resistance, high; machinability, good; dimensional stability, good; moisture absorp, low; soluble in ketones and esters, slightly attacked by alcohols and hydrocarbons.

NIXON C/N (Cellulose nitrate plastics)—Nixon Nitration Works, Nixon, N. J.

Thermoplastic: For molding machining stamping and forming into parts. Abrasion resistance, medium; resists corrosion caused by water, hydrocarbons, diluted alkalies and acids; max cont serv temp, 160 F; flexible; dielectric str, 300-500 (volts per mil inst); ts, 600-9000 psi; comp str. 20-30,000; moisture absorp, low; in color; shatterproof; sp gr, 1.39-1.45; transparent, translucent and opaque; machinability, good; bhn, 8-11. For handles, knobs, nameplates, etc.

NIXON E/C (Ethyl cellulose plastics)—Nixon Nitration Works, Nixon, N. J.

Thermoplastic: Sheet, rods, tubes, and granules for injection molding, blow molding, and extruding. Abrasion resistance, medium; affected slightly by weak acids; decomposes in strong acids; max cont serv temp, 140-200 F; flex str (ASTM D 650-42T), 9000-10,000 psi; dielectric str, (volts per mil inst), 470-550; ts, 2,500-8000 psi; unlimited color possibilities in transparent, translucent and opaque; moisture absorp, low: sp gr, 1.08-1.18; machinability, good; dimensional stability, good; toughness and strength, good; low-temperature shock resistance. For motor housings, electrical appliances, etc.

NIXON V/L (Rigid vinyl) — Nixon Nitration Works, Nixon, N. J.

Thermoplastic: Sheets. Properties: Ts, 7-10,-000 psi; imp str (Izod), 0.4-0.75 ft-lb; dielectric str, 425 (volts per mil inst); machinability, good; flammability, self-extinguishing; water absorp, none; dimensional stability, excellent; soluble in lower boiling ketones.

NON-GRAN (Bronze) — American Non-Gran Bronze Co., Berwyn, Pa.

Cu 88, Sn 10, Zn 2. Rough bars or billets, sand and permanent-mold castings. Properties, unheat-treated: Ts, 40,000 psi; ys, 22,-000 psi; elong in 2 in., 15%; bhn, 80; weight, 0.316 lbs per cu in.; nonmagnetic; weldability, poor; abrasion resistance, high. For heavy-duty bushings and bearings.

NORCELL (Ethyl-cellulose plastic) — Norrell Inc., Memphis 12, Tenn.

RX76: Thermoplastics. Blocks for casting and dipping. Abrasion resistance, low; chemical resistance, excellent to acids and alkalies; soluble in organic solvents; max cont serv temp, 150 F; opaque in all colors except pure white; moisture absorp, low; sp gr, 0.97. For potting and coating of electrical coils and condensers. Also for coating mechanical parts to protect them against damage and corrosion.

Strippable: Thermoplastic. Blocks. Chemical resistance, excellent to acids and alkalies; soluble in organic solvents; max cont serv temp, 130 F; ts, 350 psi; transparent in amber; moisture absorp, low; sp gr, 0.97. This is a hot-dip, strippable coating for protection of precision parts in storage and shipment.

NOVO SUPERIOR (High-speed steel)—H. Boker & Co., Inc., N. Y. C.

An 18-4-1 (W-Cr-V) steel with maximum red hardness and wear resistance. For punches, broaches, cutters, knives, reamers, drills, etc.

NUBRAZE (Silver brazing alloys)—Sherman & Co., Flushing, N. Y.

Contains silver, copper, cadmium and zinc in varying percentages. Straight and coiled strip, wire and powder metal. For repairing broken tool bits, hobs, milling cutters, etc. Also for mounting carbide tips.

Silver brazing paste: Powdered silver brazing alloy, pre-mixed with special flux. For silver brazing all ferrous and nonferrous metals which can be silver brazed. Excellent for joints of large or long cross sections. Perfect for applications where preplacing of silver brazing alloy is difficult or impossible.

NUREX (Alloy steel castings)—National Malleable & Steel Castings Co., Cleveland.

A Cr-Mn-C alloy in castings. Resists corrosion caused by dilute aqueous solutions and acids (except phosphoric). Max cont serv temp, 1700 F. Abrasion-resistant. For mill balls, lining and similar purposes.

NYLATRON G (Graphite impregnated nylon)—The Polymer Corp., Reading, Pa.

Rod, strip and casting tube form. Thermal exp'n about 40% lower than unfilled nylon; abrasion resistance, excellent; machinability, poor (grade GS with good machinability is also available); Toughness lower than unfilled nylon. For cam followers, drawer rollers, conveyor track linings, etc.

NYLON (Polyamide thermoplastic)—E. I. du Pont de Nemours & Co., Inc., Polychemicals Dept., Wilmington, Del.

Molding powder and filaments. Fabricated into parts by injection molding, transfer molding, extruding and machining.

Max cont serv temp, depends on type, highest about 400 F; flex str, various types, 3800-14,600 psi; dielectric str, 385-420 (volts per mil inst); ts, 7400-10,900 psi; in natural and a few colors; moisture absorp, medium; sp gr, 1.09-1.14; translucent in thin layers, opaque in heavy layers; machinability, good; Rock hdns, R83-118. Tough, abrasion-resistant, easily molded into complicated and delicate shapes; heat-resistant; sterilizable. For coil forms, impact devices, sheathing on insulation, light-load, low-speed gears, and bearings.

OHIO (Carbon and Carbon-graphite)—Ohio Carbon Co., Cleveland 11.

Carbon in rods or plates. Abrasion resistance medium; chemical resistance, high; ma cont serv temp, 400-500 F; flexibility, low ts, 2275 psi; comp str, 7-9000 psi; trans st 6500 psi or more; moisture absorp, low in black and natural; machinability, fai For bearings such as slow speed bearing and thrust bearings, seals for pumps, et

OHMALOY (Electrical steel) — Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

Cr 12, Al 4.25, Fe bal. A steel for high elec trical resistance applications, such as moto starters, crane motor controls, and min locomotive controls. Available in all forms

OHMOID (Phenolic plastics)—Wilmington Fibre Specialty Co., Wilmington 99, Del.

Thermosetting: Laminated sheets, rods an tubes, for machining or stamping into parts dielectric str, 200-700 (volts per mil inst) moisture absorp 2%; insoluble in ordinary solvents; high polish; corrosion-resistant; ts 10-14,000 psi; max cont serv temp, 250-300 F. For electric and mechanical insulation

OILITE (Powder metals)—Amplex Mfg. Co. Div. of Chrysler Corp., Detroit 31, Mich

Oilite bronze: Heavy-duty self-lubricating precision bronze bearings; 25% oil by volume. Wide ranges of sizes in plain flange, thrust, self-aligning bearings. Used extensively in aircraft, motor vehicles, farm implements, home appliances, electrical equipment, textile machinery, food processing and packing machines, etc. Cored and solid bars, plates, and sheet stock.

Super-Oilite: Porous, oil-cushion, extreme pressure, self-lubricating iron alloy bearing. Allowable static bearing load, 22,000 psi. High oil content, strength and ductility. Finished bearings and cored, solid, and plate stock.

Super-Oilite 16: Porous, oil-cushion, extreme high-pressure self-lubricating bearing. For high loads at low velocities. Extreme hardness combined with high oil content, for static bearing loads up to 100,000 psi.

Iron Oilite: Porous, pure iron (copper free), oil-cushion, self-lubricating bearing. Resistant to chemical and corrosive actions, particularly of sulphur and its compounds. Used especially for bearings in pumps.

Stainless Steel Oilite: For bearing applications in which anticorrosion properties are required.

Oilite Machine Parts: Eliminate machining. Made by powder metallurgy from nonferrous and ferrous alloys. Wide range of physical properties. Reduce tool-up time and cost.

Oilite Filter Materials: For filtering, controlling flow, diffusing, flame-arresting, etc. High flow with low resistance. Calibrated porosity. From variety of metals and alloys, including stainless steel.

Oilite Friction Materials: Powder metallurgy products. High heat conductivity; uniform friction qualities; resistant to high temperatures and to glazing and wear. For clutch, brake, and similar applications.

OILWAY (Die steel)—H. Broker & Co., Inc., New York.

C 0.94, Si 0.33, Mn 1.23, W 0.57, and Cr 0.44. Bars, drill rods and forgings. Ts, (as cast), 150,000 psi; (bar stock), 200,000 psi; comp str, 350,000 psi. For all types of dies, gages, reamers, broaches and punches.

OLDS BEARING BRONZE (High leaded nickel-bronze)—Olds Alloys Co., Southgate, Calif.

Ingot and sand castings. Properties, heat treated: Ts, 38,000 psi; ys, 28,000 psi; elong in 2 in., 8-12%; impact str (Izod), 5-7 ft-lb.; sp gr, 9.2; nonmagnetic; weldability, fair; max cont serv temp, 400 F; abrasion resistance, medium to high. For general bearings subjected to heavy loads and high speeds.

OLDSMOLOY (Cr-Ni-Mo-bronze) — Olds Alloy Co., Southgate, Calif.

Ingot and sand castings to specification. Properties, normalized: Ts, 80,000 psi; ys, 47,000 psi; elong in 2 in., 15-20%; bhn, 160-170; sp gr, 8.4; nonmagnetic; weldability (gas), good; max cont serv temp, 500 F; abrasion resistance, medium to high. For parts in food and chemical machinery of all kinds, for heavily loaded bearings, pintle and detachable chains.

ORCO (Natural and synthetic rubbers)—Ohio Rubber Co., Willoughly, O.

All natural and synthetic rubbers in sheet, channel, strip tubing and special shapes. Also molded and extruded parts and rubber-to-metal parts to specifications.

ORNAMETL (Wood veneer on steel)—Haskelite

Mfg. Corp., Grand Rapids 2, Mich.

Veneer on steel. Sheets for stamping, rolling and pressing. Semi-inflammable; moisture absorp low; mahogany, walnut and birch veneers; shatterproof, machinability, good. For airplanes, buses, street cars, railways, etc.

ORRWELD (Welding rods)—Orweld Inc., Pittsburgh 33.

Complete line of welding electrodes and acetylene welding rods.

OSTUCO (Steel tubing) — Ohio Seamless Tube Co., Shelby, O.

Seamless and electric-welded. Formerly known as Ohio Special Quality tubing.

OTISCOLOY (Special steel)—Jones & Laughlin Steel Corp., Pittsburgh 30.

Low-alloy high-strength steel. Used in trailer trucks, busses and freight cars for greater strength for equivalent weight or reduction in weight with maintenance of strength. Properties (as rolled over ½ to 1 in. inc. thickness or diameter): Ys, 47,000 psi; ts, 67,000 psi; easily welded, easily formed; resists corrosion and abrasion.

OXWELD (Welding rods)—Linde Air Products Co., New York 17.

No. 1 H.T.: High-test steel rod for high-strength welds in plate, sheet, structural shapes, pipe and steel castings. Weld metal susceptible to same heat treatment as casting.

No. 6 CM: Steel rod designed principally for making high-strength welds in base materials which are to be heat treated after welding, such as aircraft parts containing C, Mn, Si, Mo and Cr. Also for building up wear resisting surfaces on pressure rolls, shovel teeth, grinding mills, etc.

No 7: Drawn iron rod, copper-coated, for steel plate, sheet, structural shapes and pipe. Produces ductile, readily machinable welds sufficiently strong for ordinary purposes where high tensile strength is not a factor.

No. 25M: Bronze rod for high-strength, wear-resisting welds in copper, brass or bronze and for bronze-welding malleable iron, steel or cast iron. Melts rapidly, flows freely, tins easily, and solidifies quickly. Machinability, excellent; weld metal free from porosity and inclusions. Weld deposit hardness, bhn, 96; withstands elong to 50% measured by free-bend tests.

No. 25M: Also produced in flux-coated bronze rod.

No. 31T: Bronze rod for building up wear resisting surfaces subject to heavy loading especially where elevated temperatures are encountered. Harder than No. 25M but less ductile. Preferable to 25M for moving parts, such as pistons, piston rods, guides, slide valves and similar parts.

No. 19: Cupro rod for rail bonding and metal furniture manufacture. Free flowing phosphor bronze rod, it solidifies quickly, produces practically no slag and requires no flux. For bonding rail ends.

No. 28: Columbium-bearing 18-8 stainless steel rod for titanium or columbium-bearing 18-8 stainless steels and untreated stainless steels. Produces corrosion-resistant, ductile and malleable welds.

No. 32CMS: Steel rod for high-strength and high-speed welding of pressure vessels, tanks and steel pipe by Linde's steel-welding process. Produces welds with tensile strengths between 75,000 and 90,000 psi.

No. 23: Drawn aluminum rod for cast and sheet aluminum and aluminum alloys. Has lower melting point than pure aluminum and its alloys. Cooling stress absorbed by plastic weld metal which contracts slightly during solidification. Parts to be welded can be held rigidly in jigs or fixtures.

No. 14: Drawn aluminum rod for sheet aluminum and 2S and 3S aluminum-manganese alloys. Used where high strength is not required.

No. 26: Everdur bronze rod for Everdur and other silicon-bronze plate, sheet and castings. Produces weld metal as strong as base plate and has equal resistance to corrosion. Welds have ductility of approximately 40 to 60% as measured by free-bend test.

No. 9: Cast iron rod for fusion welding gray iron castings. Deposits fine-grained weld metal as strong as casting and is easily machined.

OXYCUTTEND (Arc-oxygen cutting rods)—Arcos Corp., Philadelphia 43.

Coated tubular rod for cutting metals by the Oxyarc process. Cuts all metals using electric arc and stream of oxygen to achieve cutting.

P (Polystyrene plastic)—Sandee Manufacturing Co., Chicago 30.

Polystyrene thermoplastic rods, tubes and special shapes. Chemical resistance, excellent to inorganic acids and alkalies in all concentrations: flex str (ASTM D 650), 8000-19,000 psi; dielectric str, 500-700 (volts per mil inst); ts, 5-8500 psi; imp str (Izod), 0.3-0.4 ft-lb per inch of notch; all colors; moisture absorp, low; sp gr, 1.05-1.065; transparent, translucent, opaque; machinability, good; coef thermal exp'n 6-8 x 10^{-5} inch/inch/degree C.

PAGE (Wire)—Page Steel & Wire Div., American Chain & Cable Co., Inc., Monessen, Pa.

Low and high-carbon steel wire, also ingot, iron wire and stainless steel wire, furnished in various strengths and hardness numbers. Same analysis in shaped wire for special purpose.

PAISLEY (Adhesives) — Paisley Products Inc., Chicago 16, Ill.

Wide variety of adhesives including glues, pastes, resins, cements, etc.

PALINEY (Palladium-platinum-silver-copper-nickel alloy)—The J. M. Ney Co., Hartford, Conn.

No. 6: Wire, sheets, coiled strips, and plates for stamping, turning, boring, welding and soldering. Properties, heat-treated: Ts, 170,000 psi; ys, 127,000 psi; elong, 15%; bhn, 270; sp gr, 10.9; nonmagnetic; abrasion resistance, medium. Used for pivots, small bearings, springs, electrical contacts, etc.

No. 7: Similar to No. 6 in analysis with the addition of gold. Available also in the same form. Properties, heat-treated: Ts, 180,000 psi; ys, 148,000; elong 9%; impact resistance, high; bhn, 280; sp gr, 11.9; nonmagnetic; weldability, good. Fore same uses as foregoing.

PAL-WELD (Tinning and soldering compound)—Pal-Weld Mfg. Co., Seattle 4.

Powder form. Used on all metals except aluminum. For tinning bearings and welded seams.

PAMUDO (Plywood)—Pacific Mutual Door Co., Tacoma 1, Wash.

Douglas fir plywood in stock sheet sizes and sizes to specification. Chemical resistance, high; impact resistance and ts, high. (U. S. Commercial Standards CS-45-45). For various industrial applications and uses in conjunction with metal parts.

PANELYTE (Thermosetting sheet plastics)—Panelyte Division, St. Regis Paper Co., New York.

Melamine formaldehyde and phenol formaldehyde sheets, laminates, rods and tubes. Also fabricated parts and molded specialties. Chemical resistance: Unaffected by water, brine, oil, ordinary organic solvents, coolants, ketones, esters, most weak acids or weak alkalies; max cont serv temp: Cellulosic base, 225 F; asbestos base, 300 F; glass base, 350 F; flex str (ASTM D-790-45T). 12,000-69,000 psi; dielectric str, short time test, $\frac{1}{16}$ in. thickness, up to 1100 volts per mil; ts, 7-52,000 psi: compr str, 20-55,000 psi; imp str (Izod), 0.5-37; black and natural color, moisture absorp, 0.05%-3.3%; sp gr, 1.20-189; opaque; machinability, good; coef thermal exp'n. .00000787 in./in./deg C. For gears, cams, bed plates, jigs and fixtures.

PAR (Alloy steel sand castings)—Crucible Steel Castings Co., Cleveland.

No. 2: C 0.25, Si 0.45, Mn 0.65, Ni 2.75, Cr 1.75, Mo 0.3, P 0.05. Sand castings. Properties heat-treated: Ts, 100,000 psi; ys, 75,000 psi; elong, 20%; impact resistance, low; bhn, 230; magnetic; abrasion resistance, high; can be heat-treated for good wear resistance.

No. 6: C 0.2 max, Si 0.85, Mn 0.7, Cr 25, Ni 12. Sand castings. Properties, heat-treated; Ts, 80,000 psi; ys, 42,000 psi; elong, 32%; impact resistance, high; bhn, 165; sp gr, 7.5; nonmagnetic. Resists corrosion caused by sulphur dioxide; max cont serv temp, 2000 F; abrasion resistance, low. Used for furnace parts and machine parts where corrosion resistance is desired.

No. 7: C 0.3, Si 0.85, Mn 0.7, Ni 35, Cr 15. Sand castings. Properties untreated: Ts, 73,000 psi; ys, 41,000 psi; elong, 7%; impact resistance, low; bhn, 170; sp gr, 7.8; nonmagnetic; corrosion resistant; good for hydrochloric acid solution; max cont serv temp, 2000 F; abrasion resistance, low. For heat-treating furnace parts, carburizing boxes, etc.

PARACRIL (Buna N-type rubber)—Enjay Co. Inc., New York 19.

Bale or crumb form. Abrasion resistance, high; especially resistant to petroleum hydrocarbons, fats, oils and alcohols; can be compounded and cured to withstand max cont serv temp, 300 F; flexibility, high; dielectric str (volts per mil inst), 380; ts, 100-4000 psi; elong, 100-800%; compr set, 3.5% min.; moisture absorp, low; flexibility at extremely low temperatures; sp gr, 0.96-0.98; hardness, 10-100 Shore Durometer A; light-colored; can be compounded to any desired color. For revolving shaft and bearing seals, flexible hose, vibration damping units, rolls, casters, flexible couplings, packings, gaskets, boots, mountings, diaphragms, milking machine inflations, etc.

PARAPLEX (Plastic resins)—Rohm & Haas Co., The Resinous Products Div., Philadelphia.

Liquid form for casting and laminating; abrasion resistance, high; has excellent resistance against acids, alkalies, solvents; transparent; machinability, good.

PAR-EXC (Alloy tool steel) — Vanadium Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

C 0.50, Si 0.28, Mn 0.20, W 2.00, Cr 1.65 and V 0.25. Rough bars or billets, finished rods or bars, wire, sheet, plate forgings and drill rods, for machining, hot and cold working, stamping, drawing and brazing. Properties heat-treated: Rock hdns, C58 max; magnetic; weldability, fair; max cont serv temp, 600-800 F; abrasion resistance, medium. For wearing parts requiring a hard surface and a very high-strength core.

PARIAN (Plastics)—American Hard Rubber Co., New York 13.

Sheet, rods and tubes. Abrasion resistance, low; resistant to almost all alkalies, acids, solvents at low temperatures; max cont serv temp 105 F; slow burning; flexibility, high; dielectric str, 500-700 (volts per mil inst); ts, 1800-3000 psi, flex str, 15-1700 psi; elongation, 50-600%; moisture absorp, 0.01%; wide range of colors; shatterproof; sp gr, 0.93; translucent and opaque; machinability, good; Rock hdns, R25-35.

PARNAL (Plastics)—American Hard Rubber Co., New York 13.

Sheets, rods and tubes. Abrasion resistance, low; slightly attacked by dilute acids and alkalis; soluble in esters and ketones; max cont serv temp, 185 F; slow burning; flexibility, high; dielectric str, 250-365 (volts per mil inst); ts, 1500-8200 psi; flex str, 2000-14,000 psi; elongation, 7-800%; moisture absorp 2-6%; any color; sp gr, 1.27-1.37; transparent, translucent and opaque; machinability, good; Rock hdns R40-125; Tough, high-impact, flexible plastic.

PARSAN (Polystyrene plastic)—American Hard Rubber Co., New York 13.

Thermoplastic: Sheet, rods and tubes. Abrasion resistance, medium; resistant to alkalis and weak acids; max cont serv temp, 200 F; flex str, 4800-19,000 psi; dielectric str, 500-700 (volts per mil inst); ts, 3000-8500 psi; impact str (Izod), 0-25-0.6 ft-lb; any color; moisture absorp 0.04%; sp gr, 1.06; transparent, translucent and opaque; machinability, fair; Rock hdns, M55-95. Features excellent electrical characteristics plus dimensional stability.

PC (Foamglas insulation)—Pittsburgh Corning Corp., Pittsburgh 22.

Cellular glass insulation in block form. Abrasion resistance, low; chemical resistance, impervious to common acids and acid fumes; service temperature range, —350 to +212 F; noncombustible; flexibility, low; compr str, 140 psi; moisture absorp, low; black; sp gr, 0.16; opaque; machinability, good; coef thermal exp'n 0.0000040 per deg F. High moisture and vapor resistance, fireproof and acidproof. Long life insulation for buildings, process equipment and pipe lines.

P. E. (Plastic)—Sandee Manufacturing Co., Chicago 30.

Polyethylene plastic rods, tubes and special shapes. Resists strong acids, alkalies, most organic solvents at moderate temperatures. Dielectric str, 460 (volts per mil inst); ts, 1300-1900 psi; most pastel colors; moisture absorp, low; sp gr, 0.92; translucent and opaque; coef thermal exp'n, 16-18 x 10^{-5} inch/inch degree C. For electrical insulation and insulator parts.

PEERLESS (Fish paper insulation) — National Vulcanized Fibre Co., Wilmington, Del.

Converted cotton cellulose, chemically pure, fish paper insulation. Sheets and rolls: Dielectric strength, high; tough; spring and bending properties, good. Used extensively for generator and motor insulation applications.

PENACOLITE (Adhesives)—Chemical Division, Koppers Company, Inc., Koppers Building, Pittsburgh 19, Pa.

G-1131: Resorcinol resin adhesive in two parts, capable of curing at room temperatures, providing durable, water-proof, fungus-proof bonds. Part A is a resin solution, part B a powdered setting agent. Recommended for bonding all cellulosic materials, many thermoplastic and thermosetting plastics, as well as some synthetic rubbers. Can be used with pressures as low as 25 psi. Recommended for use in joining wood where strength and proof against water, weathering, dampness and fungi are required. For bonding oak, G-1124 is recommended.

G-1124: Resorcinol resin adhesive in two parts, capable of curing at room temperatures. Part A consists of a resin solution containing reinforcing filler, part B the liquid formaldehyde setting agent. Recommended for bonding all cellulosic materials, and particularly for oak wood. Can be used with pressure as low as 25 psi. Recommended for use where strength and proof against water, weathering, dampness and fungi are required.

G-1215: Resorcinol-phenol resin adhesive in two parts, capable of curing at room temperatures, providing durable, water-proof, fungus-proof bonds. Part A is a resin solution, part B a powdered setting agent. This somewhat lower cost adhesive is recommended for the same uses as G-1131 and provides an equal bond where strength and resistance against water, weathering, dampness and fungi are required.

PENN (Bronze welding rod)—Titan Metal Mfg. Co., Bellefonte, Pa.

Alloy W-16: Properties, V-weld; Ts, 52-57,000 (avg); Rock hdns, B57-60. Melt pt, 1628 F; shear str, 62,800 psi; low fuming; double deoxidation, good tinning, excellent flow.

PENN (Fiber)—Penn Fibre & Specialty Co., Phjladelphia 34.

"B" Board: Pulp board in sheets and strips, for stamping and forming. Abrasion resistance, low; max cont serv temp, 200 F; flexibility, high opaque. For washers, gaskets, stampings for electrical parts, etc.

Vulcanized fiber: Paper base material in sheet and rods or tubes, for machining or stamping into parts. Abrasion resistance, low; resists corrosion caused by oils and greases, flexibility, low, and high when treated with glycerine; ts, 6500-8500 psi; comp str, 20-35,000 psi; nonflammable; in red, gray, white and black olive; shatterproof; sp gr, 1.36-1.4; corrosion-resistant. For insulation, special gaskets, washers, special parts, dust-guards, pulleys and gears, etc.

PENNVERNON (Double-strength window glass)—Pittsburgh Plate Glass Co., Pittsburgh 19.

Generally chemical resistant; nonflammable; flexibility, low; ts, 6500 psi; moisture absorp, low; sp gr, 70 F, 2.52; transparent. Used where unusual strength required.

PERDURO (Pearlitic malleable irons)—Jeffrey Mfg. Co., The, Columbus 16, O.

Properties, heat-treated: Ts, 80,000 psi min; ys, 60,000 psi min; elong in 2 in., 8% min; bhn, 187-217; corrosion resistance, good; abrasion resistance, good. For chain links, sprockets, etc.

PERMACLAD (Stainless clad steel)—Alan Wood Steel Co., Conshohocken, Pa.

Type 304 stainless with 1008 analysis backing steel. Both the stainless and backing steel can be changed to meet individual requirements. Sheet and plate. Weldability, good; corrosion resistance, same as type 304 stainless.

PERMANITE (Furnace resin thermosetting plastic)—Maurice A. Knight Co., Akron 9, O.

Sheet or laminated form, for compression molding and casting. Abrasion resistance, medium; resistance to acid and alkalies, excellent; max cont serv temp, 350 F; ts, 1000 psi; comp str, 50,000 psi; in black only; moisture absorb, low; sp gr, 90 lb per cu ft; opaque. Used as acid and alkali-proof cement and for structural parts exposed to acids and alkalies. Can also be cast into various shapes in rubber molds, cellulose acetate molds and steel molds.

PERMITE (Aluminum-base alloy Castings)—Aluminum Industries, Inc., Cincinnati.

Following grades are available as sand castings, permanent-mold castings, and high pressure die castings.

No. 1003: Cu 1.0, Si 12.0, Fe 1.0 max, Mg 1.0, Ni 2.50, balance Al. Low coef of thermal exp'n; high wear and heat resistance. For automotive pistons.

No. 1004: Cu 7.0, Si 1.5, Zn 2.00 max, balance Al. For waffle grids, washing machine agitators and miscellaneous appliance parts.

No. 1008: Cu 4.5, Si 2.5; Fe 1.2 max, balance Al. For machine parts to resist shock. Heat treatment is to soak at critical and quench in water, and reheat at 350 F to desired properties.

No. 1019: Sand and permanent-mold castings. Si 5, Cu 1.25, Mg 0.5, balance Al; furnished heat treated. Suitable for highly-stressed parts including airplane engine parts.

No. 1020: Si 7.00, Mg 0.20 to 0.40, balance Al; furnished heat treated. Suitable for castings of thick and thin section. Corrosion resistant for marine work and pressure tight applications.

No. 2011: Si 5, balance Al. For parts subject to atmospheric corrosion.

No. 2021: Mg 4, balance Al. For parts subject to salt water corrosion.

No. 1034: Cu 3, Si 9.5, Fe 1.2 max, Mg 1.00, Ni 1.0, balance Al. For pistons for automotive, pump and refrigeration service.

PERMIUM (Sintered alloys)—The Paraloy Co., Chicago 22.

Permium alloys are not extremely hard but rather dense tough, smooth and very resistant to abrasions, heat, cold, magnetism, vibration, etc. Characteristics of one type of Permium are: Melt pt, 2750 F; electrical resistivity, 5.78 microhm-cm; thermal coef of linear exp'n, 0.68×10^{-6}; Rock hdns, 60-65 C. Permium alloy can be welded to various materials such as bronze, copper, brass, steel, monel, aluminum, etc. For moving elements of precision instruments.

PERMOLD (Aluminum castings)—The Permold Co., Medina, O.

Sand-cast and permanent-mold aluminum castings of standard analyses to specification.

PETERSON (Steel)—Peterson Steels Inc., New York 17.

An SAE 52100 steel in following analysis: C 0.95-1.10, Mn 0.25-0.45, Si 0.20-0.35, P 0.25 max, S 0.25 max, Cr 1.30-1.60, Ni 0.35 max, cu 0.25 max, Mo 0.08 max. Rough bars or billets, finished rods, forgings, bars and tubing; abrasion resistance, high. For ball and roller bearings, spindles, thrust collars, hardened sleeves, clutch liners and faces, etc.

PHEMALOID (Plywood)—Haskelite Mfg. Corp., Grand Rapids 2, Mich.

Compound lumber, phenolic resin bonded. Sheets, waterproof; resistant to fungus, bacterial decay, and diverse climatic conditions; bendable to desired forms. For truck, bus and train floors, boat hulls and decks, etc. Flat stock only, sizes 48 x 96 in. and 72 x 96 in.

PHENOLITE (Laminated plastics) — National Vulcanized Fibre Co., Wilmington, Del.

With base of paper, asbestos paper, cotton, asbestos and glass cloths in sheets, rods, tubes and fabricated shapes; also laminated with rubber sheet. Dielectric and mechanical str, high; moisture absorp, low; heat resistant; nonfusible; resistant to acids, solvents and oils; resistance to wear and impact, high; machinable. Used in electrical, mechanical and chemical applications for silent gears, bearings, bushings, washers, valve disks and terminal strips, etc.

PHENOPREG (Resin impregnated paper and fabrics) — Fabricno Products Inc., River Rouge 18, Mich.

Melamine formaldehyde and phenol formaldehyde thermosetting plastic sheet. Abrasion resistance, high; flex str (ASTM D 790), 20,000 psi; ts, 10,000 psi; comp str, 25-63,000 psi; variety of colors and patterns; moisture absorp, 2.5% in 24 hours; sp gr, 1.3-1.8; translucent and opaque; used for gear blanks.

PHILO (Ferro alloys)—Ohio Ferro Alloys Corp., Canton, Ohio.

Ferro alloys for deoxidizing agents and for alloying in the production of iron and steel.

PHOSCO (Brazing alloy)—United Wire and Supply Corp., Providence 7, R. I.

Cu 92.5, P 7.5. Low temperature brazing small and medium size and weight parts where gap clearances are close—from a drive-fit to not more than 0.005 in. Properties: Ts, 85,000 psi; solidus, 1300F; liquidus, 1400F.

PHOS-COPPER (Brazing alloy) — Westinghouse Electric Corp., East Pittsburgh, Pa.

Rod or strip containing 5-7% phosphorus and balance copper. More economical than silver brazing alloys and produces good joints on copper without use of brazing flux or on nickel base alloys, brasses, and bronzes with proper fluxes.

PHOSNIC (Bronze)—Chase Brass & Copper Co., Waterbury 20, Conn.

Cu 98.15, Ni 1.10, P 0.25. Wire. Properties, heat-treated: Ts, 120,000 psi; ys, 105,000 psi; elong in 2 in., 3%; Rock hdns, B95; nonmagnetic; resists industrial atmospheres, sea air and water, many saline solutions and dilute acids. For bolts, screws, rivets, springs, etc.

PHOSON (Brazing alloy)—United Wire and Supply Corp., Providence 7, R. I.

Ag 6.0, Cu 86.5, P 7.5. Suited for brazing larger and heavier parts than phosco or where joint design and gap clearances do not provide ideal brazing conditions. Properties: Ts, 95,000 psi; solidus, 1175F; liquidus 1445F.

PHOS-TRODE (Coated phosphor-bronze electrodes)—Ampco Metal, Inc., Milwaukee 46.

Heavily coated, shielded-arc electrode for metal-arc welding copper, tin bronzes, brasses, galvanized iron, cast and malleable iron and dissimilar metals in all positions—flat, vertical, overhead. Spray type arc action, low spatter loss, ease of manipulation, high deposition rate, dense deposit, smooth flowing characteristics allow its use with success where either joining or overlaying welds are required of a phosphor-bronze composition. Recommended for deep-groove welding in fabrication of phosphor-bronze pressure vessels. For repair welding of cast iron overlaying many types of bearings and corrosion-resistant applications. Conforms to AWS-ASTM Spec. E Cu SM-A.

PHOTOELASTIC FOSTERITE (Plastic resin)—Westinghouse Electric Corp., East Pittsburgh, Pa.

Styrene-alkyd type of thermosetting resin for use in "frozen stress," three-dimensional photoelastic tests. Cylinders 4 inches and 6 inches nominal diameters; lengths, approx 20 and 40 inches; special shapes obtainable on development basis. Relatively free of time-edge stresses. Critical temp, 85 C; critical fringe value, 4.00 psi tension per inch of thickness; critical modulus of elasticity, 2420 psi; effective fringe value, 3.85 psi tension per inch of thickness; effective modulus of elasticity, 2320 psi; figure of merit ($Q=E_{eff}/F_{eff}$), 603; Poisson's ratio (85 C), 0.48; proportional limit (optical, 85 C), 190; ts (5-minute loading—85 C), 515; index of refraction (25 C), 1.61 (approx); coef thermal exp'n (in./in./degree C, 20 — 90 C), 200 x 10^{-6}; wt, 0.0418 lb/cu in.; Rock hdns (25 C), M60.

PICCOLASTIC (Polystyrene thermoplastic plastics)—Harwick Standard Chemical Co., Akron, O.

Solid form for casting and hot melting. In clear colors. Sp gr, 1.02; transparent.

PINCO (Porcelain) — The Porcelain Insulator Corp., Lima, N. Y.

Wet plastic process high-tension porcelain insulators and clamps and fittings for use with same.

PIONEER (Nickel-chrome alloy steel)—Pioneer Alloy Products Co., Cleveland 12.

Sand castings to specification. No heat treatment required. Ts, 74,000 psi; ys, 36,500 psi; elong in 2 in., 42%; sp gr, 7.833; nonmagnetic; resists corrosion caused by sulphuric, nitric, phosphoric and other acids; abrasion resistance, high.

PITALOY (Manganese-molybdenum steel)—Pittsburg Steel Foundry Co., Glassport, Pa.

Ts, 85,000 psi; ys, 55,000 psi; elong, 22% reduction of area, 40%; machinability, good. Used for locomotive frames, crossheads, coupling boxes and spindles, driving wheel centers, gears, etc.

PITT (Babbitt)—Pitt Metals Co., Pittsburgh 24. In bars and pigs. For all bearing work, heavy-duty, high-speed, rolling mill, etc.

PITTSBURGH (Plate glass) — Pittsburgh Plate Glass Co., Pittsburgh 19.

Plate glass generally chemical resistant; nonflammable; low flexibility; ts, 6500 psi; compr str, 36,000 psi; moisture absorp, low; available in water white, blue, flesh-tinted, blue-green; sp gr at 70 F, 2.52. For food processing equipment, etc.

PITTSBURGH (Steels) — Pittsburgh Steel Co., Pittsburgh 30.

Carbon and alloy steels, carbon and alloy wire and rods, and carbon, alloy and stainless seamless tubes to standard specifications such as ASI and SAE Analyses.

PLASKON (Thermosetting plastics) — Plaskon Division, Libbey-Owens-Ford Glass Co., Toledo.

Urea-formaldehyde, thermosetting materials: Powder and granules for compression and

transfer molding; abrasion resistance, high; resists corrosion caused by weak acids and alkalies; max cont serv temp, 170 F; flex str, 10-16,000 psi (ASTM D 790-45T); dielectric str, 300-400 (volts per mil inst); ts, 8000-13,000 psi; comp str, 25-35,000; impact str (Izod), 0.24-0.35 ft lb; moisture absorp, medium; in colors; sp gr, 1.47-1.52; translucent. Used for housings, trim, knobs, dials, etc.

Thermoplastics. Powder, sheets, rods and tubes rial: Powder and granules for compression and transfer molding. Abrasion resistance, high; resists corrosion caused by weak acids and alkalies; max cont serv temp, 210 F; dielectric str, 300-400 (volts per mil inst); ts, 8000-13,000 psi; comp str 25-35,000; in colors, sp gr, 1.47-1.52; translucent. For handles, dials, gage plates etc.

PLASKON ALKYD (Thermosetting plastic)—Plaskon Div., Libbey-Owens-Ford Glass Co., Toledo.

Mineral-filled, thermosetting. Powder and granule form for compression molding. Properties: Ts, 3-4,000 psi; flex str, 8-10,000 psi; comp str, 18-20,000 psi; mod of elast, 2.5 x 10^6; imp str (notched Izod), 0.18 ft-lb; dielectric str at 77 F, 325-335 (volts per mil inst), at 212 F, 440-460 (volts per mil inst) both step by step tests; arc resistance, 200 sec; max cont serv temp 400 F. Rapid cure. For electrical connectors, switch units, etc.

PLASTACELE (Cellulose acetate plastic)—E. I. du Pont de Nemours & Co., Polychemicals Dept., Wilmington, Del.

Thermoplastics. Powder, sheets, rods and tubes for machining and molding. Swaged and machined articles are affected only slightly by weak acids and alkalies: decomposed by strong acids and alkalies; soluble in acetone, acetates, etc. Max cont serv temp, 165-190 F at 66 psi; flexural str, 6-9000 psi (ASTM D 650-42T); dielectric str, 275-350 volts per mil; ts, 2800-8000 psi; comp str, 4-7000 psi; impact str, 1.0-4.0 ft-lb (Izod); in colors; moisture absorp, medium; sp gr, 1.27-1.37; transparent, translucent and opaque. For oil gages.

PLAST-CORIRON (Metal powder)—Plastic Metals Div., The National Radiator Co., Johnstown, Pa.

Separate unblended powders of 98.5% iron. Not used for sintered parts. Has exceptional magnetic and electrical properties, especially high permeability at low frequencies. For magnetic cores and other electrical items.

PLASTIKFLEX (Flexible tubing, thermoplastic)—R. D. Werner Co. Inc., New York.

Flexible tubing, thermoplastic. To be extruded. Used for conduits, insulation, hose, fuel lines, hospital equipment, sleeving, spacers, stirrup pumps, gaskets, gages (square tubing for dehydration), etc.

PLAST-IRON (Metal powder)—Plastic Metals Div., The National Radiator Co., Johnstown, Pa.

99% iron. After pressing in die, sinter in protective atmosphere at 1800-2200 F from 30 to 90 minutes. Apparent density of powder, 2.2-2.7 grams per cu cm; weldability, good; abrasion resistance, high. For permanent magnets, iron cores, and other powder metal parts.

PLAST-MANGANESE (Metal powder)—Plastic Metals Div., The National Radiator Co., Johnstown, Pa.

99% Mn. Apparent density, 3.5 grams per cu cm; nonmagnetic. For alloying with iron powder in production of strong, hard ferrous parts made by powder metallurgy.

PLAST-NICKEL (Metal powder)—Plastic Metals Div., The National Radiator Co., Johnstown, Pa.

99% nickel powder, 6 to 325 mesh. Blended and separate unblended powders. For alloying with iron powder, for compacted and sintered nickel powder parts. For electrical contacts and other powder metallurgy parts.

PLASTONE (Phenol formaldehyde plastic) — National Plastics, Inc., Knoxville, Tenn.

Powder for compression and transfer molding. Abrasion resistance, high; flex str, 9-11,000 psi; imp str (Izod), 0.26-0.31 ft-lb per inch of notch; black; moisture absorp, 0.3-0.4% in 24 hours; sp gr, 1.39; opaque; machinability, good; shrinkage, 0.008-0.010 in./in.

PLAST-SILICON (Metal powder)—Plastic Metals Div., The National Radiator Co., Johnstown, Pa.

Si 97, Fe 1. Powder metal for alloying. Apparent density, 0.9 to 1.3 grams per cu cm; nonmagnetic. For parts made by powder metallurgy requiring special corrosion resistance or electrical properties.

PLAST-SPONGE (Metal powder)—Plastics Metals Div., The National Radiator Co., Johnstown, Pa.

Fe 97, C 0.9, Mn 0.3, P 0.1, Si 0.2. Powder metal. After pressing in die, sinter in protective atmosphere at 1800-2200 F from 15 to 90 minutes. Apparent density of powder, 2.2-2.7 grams per cu cm; magnetic; weldability, fair; abrasion resistance, high. For oilless bearings, iron cores and parts made by powder metallurgy.

PLAST-STEEL (Metal powder)—Plastic Metals Div., The National Radiator Co., Johnstown, Pa.

Steel powder, 100-325 mesh. Blended and separate unblended powders prepared to customers' specifications; for powder metal parts requiring high physical properties as gears, cams, pawls etc.

PLATINUM CLAD (Platinum-clad metals) — Baker & Co. Inc., Newark 5, N. J.

Pure platinum welded to various base metals, in sheet, tubing and wire. Resists corrosion caused by usual acids; abrasion resistance, medium; weldability, good; ts, ductility, etc., are dependent upon properties of base metals. Used for tubing exposed to acids and for vessels subject to same.

PLAX (Plastics)—Plax Corp., Hartford 1, Conn.

Polystyrene: Thermoplastic: Rods, sheets, tubes, films, fibers and blown ware. Ts, 5500-7000 psi; flex str, 8000-19,000 psi; compr str, 11,500-15,200 psi; Rock hdns, M 80-M 95; elong, 1.5-3.5%; softening point, 220-240 F; sp gr, 1.05-1.07; water absorp (24 hours), 0.04-0.06; machinability, fair to good. Tubing used for high-frequency electrical insulations, chemical applications, etc.

Cellulose acetate: Rods, sheets, tubes, films and fibers. Ts, 3000-10,000 psi; flex str, 1500-12,000 psi; compr str, 5000-30,000 psi; Rock hdns, M 25-M 80; elong, 7-80%; softening point, 145-260 F; sp gr, 1.27-1.37; water absorp (24 hours), 2-6%; machinability, good.

Cellulose acetate butyrate: Rods, sheets, tubes, films and fibers. Ts, 2500-6700 psi; flex str, 2000-13,000 psi; compr str, 7500-22,000 psi; Rock hdns, M 25-M 69; elong, 35-95%; softening point, 140-250 F; sp gr, 1.10-1.24; water absorption (24 hours), 1.6-2.1%; machinability, good. Sheet used for electrical and telephone insulation; rod used for knobs, handles, tool handles, etc.

Ethyl cellulose: Rods, sheets, tubes, films and fibers. Ts, 2000-9000 psi flex str, 3000-12,000 psi; compr str, 8000-20,000 psi; Rock hdns, M 25-M 65; elong, 5-100%; softening point, 200-260 F; sp gr, 1.07-1.18; water absorption (24 hours), 1.0-2.5%; machinability, good.

Polyethylene: Rods, sheets, tubes, films and fibers. Ts, 1700-1900 psi; flex str, 1500-1700 psi; Rock hdns, R 25-R 35; elong, 50-600%; softening point, 219-239 F; sp gr, 0.92; water absorption (24 hours), 0.005-0.01%; machinability, fair to good.

Methacrylate: Rods, tubes, and fibers. Ts, 4000-7000 psi; flex str, 10,000-17,000 psi; compr str, 10,000-12,000 psi; Rock hdns, M 40-M 70; elong, 1.5%; softening point, 150-230 F; sp gr, 1.16-1.20; water absorption (24 hours), 0.4-0.5%; machinability, good.

PLEXIGLAS (Acrylic-base plastics) — Rohm & Haas Co., Philadelphia 5.

Methyl-methacrylate, thermoplastic: Sheets, granules and powders for injection and compression molding and forming. Abrasion resistance, medium; chemical resistance, good; max cont serv temp, type "I-A" sheet, 140 F; type "II" sheet, 185 F; molding powder, up to 185 F; flex str, 13,000+ psi, (ASTM D 650-42T); dielectric str, 500 volts per mil (0.125-in. thick material); ts, 6800 psi min; compr str, 13-15,000 psi; imp str, unnotched, 3-4 ft-lb (Charpy); notched 0.4 ft-lb (Izod); produced in colors; moisture absorp, low; sp gr, 1.18; transparent and translucent; machinability, good. For guards, pump parts, dials, housings, etc.

PLEXIMENT (Plastics cement)—Plastic Parts & Sales, St. Louis 10, Mo.

Liquid form for cementing acrylic resin plastics parts. Furnished clear only.

PLIO-TUF (Plastic resin)—Goodyear Tire & Rubber Co., Chemical Div., Akron 16, O.

High styrene butadiene copolymer plus natural or synthetic rubber for compression and transfer molding and extruding. Abrasion resistance, high; chemical resistance, excellent; dielectric str, excellent; ts, 3-6000 psi; compr str, 2500-8000 psi; imp str (Izod), unnotched, 15+ ft-lb; variety of colors; moisture absorp, low; sp gr, 1.00 and up; opaque; machinability, good; Shore D hardness, 50-80. Extremely high resistance to impact; excellent machinability and moldability; excellent chemical resistance; readily post-formed.

PLIOVIC A and AO (Vinyl chloride copolymer)—Goodyear Tire & Rubber Co., Chemical Div., Akron 16, O.

Powders for compression molding, extruding and calendering. Abrasion resistance, high; chemical resistance, excellent; ts, 1500-4000 psi; variety of colors; sp gr, 1.355; transparent, translucent, opaque. For hose and tubing, handles, base covers, machine covers, etc.

PLURALLOY (Arc welding electrodes)—McKay Co., The, Pittsburgh 22, Pa.

70: For joining mild, low-alloy high-tensile, or high-sulfur steels. Joint properties: Ts, 75,000 psi; ys, 65,000 psi; bhn, 137; resists corrosion same as mild steel. Weld has excellent ductility and no underbead cracking, AWS E6015.

90: Joint properties, stress relieved: Ts, 87,000 psi; ys, 70,000 psi; elong in 2 in., 29%; bhn, 160. AWS E7015.

90: Joint properties, stress relieved: Ts, 87,000 psi; ys, 75,000 psi; elong in 2 in., 29%; bhn, 170. AWS E8015.

100: Joint properties, stress relieved: Ts, 95,000 psi; ys, 82,000 psi; elong in 2 in., 27%; bhn, 195. AWS E9015.

110: Joint properties, stress relieved: Ts, 104,000 psi; ys, 97,000 psi; elong in 2 in., 24%; bhn, 205. AWS E10015.

120: Joint properties, stress relieved: Ts, 110,000 psi; ys, 106,000 psi; elong in 2 in., 22%; bhn, 30.

PLUSWOOD (Resin-impregnated wood) — Pluswood Inc., Oshkosh, Wis.

Resin-impregnated plywood. In any desired thickness, in large or small sheets. In natural dark deep brown color. Has wood grain with high gloss finish; high density; lightweight; and is resistant to exposure. It can be sawed, drilled, turned, threaded, milled and tapped; nonflammable; highly resistant to decay, acids, alcoholic mixtures and other organic liquids. Sp gr, 1.3-1.4; ts (parallel laminated in fiber direction), 32-40,000 psi; comp str, 20-28,000 psi; impact (Izod), 6-8 ft-lb per in. of notch. For use as exhaust and blower fan blades, and in boat-building, aircraft and automotive industries.

PLYMETL (Sheet-metal bonded plywood)—Haskelite Mfg. Corp., Grand Rapids 2, Mich.

Resin-bonded plywood, sheet metal bonded to one or both faces. Has stiffness, rigidity, light weight; metal on both faces insuring freedom from warpage. Types available for different purposes are galvannealed steel, stainless steel, aluminum, copper, chrome zinc, chrome steel, porcelain, etc. For applications in the automotive and railroad fields.

PLYOPHEN (Plastic resins and varnishes) — Reichhold Chemicals Inc., Detroit 20.

Phenolic aldehyde, thermosetting: Liquid resins or varnishes. Soluble in water and alcohol. For laminating, impregnating, bonding and casting; abrasion resistance, high; resists corrosion caused by nearly all chemicals eexcept strong oxidizing acids and strong alkalies. Max cont serv temp, 275 F; flexibility, medium; dielectric str, 300-900 depending on the requirement; ts, 10-36,000 psi; comp str, 35,000 psi; moisture absorp, low; in natural or black; shatterproof. For use where good mechanical properties are needed along with good dielectric strength, and corrosion resistance. One type used for bonding of wood under heat and pressure for plywood. Others are laminating varnishes used with paper, canvas, fiber glass, etc., to produce phenolic laminates, properties of which depend on the type of paper, etc., used. Ts, 26,000 psi can be obtained for paper laminates; while with fiber glass, ts, 80,000 have been produced.

PLY-TECH (Plywood) — Technical Ply-Woods, Chicago 1.

Thermosetting: Sheet form for machining into parts. Abrasion resistance, good; resists corrosion, repels termites; heat resistance, good; bonded at 350 F; flexibility, medium to low depending on thickness; ts and compr strength, good to excellent depending on thickness; moisture resistance depends on treatment; machinability, excellent.

POLAROID (Light-polarizing glasses and plastic)—Polaroid Corp., Cambridge, Mass.

Principal property is 99.5% polarization of transmitted light uniformly over large area. Used for camera filters, polarizing attachments for microscopes, polarimeters, and other scientific instruments; also for polariscopes to determine strain.

POLYCO (Nylon)—The Polymer Corp., Reading, Pa.

FM 10001: Rods, strips, tubing and castings. Ts, 11,300 psi; comp str, 24,000 psi; flex str, 21,250 psi; Rock hdns, M89; heat distortion temperature (at fiber stress of 264 psi), 182 F; impact str (Izod), 0.65 ft-lb/in. of notch; sp gr, 1.14; power

factor (10^6 cycles), 0.04; dielectric constant (10^6 cycles), 3.4. Substantially inert to virtually all organic acids; carbon bisulfide, halogenated hydrocarbons, carbon tetrachloride, trichlorethylene, alkalies, soaps, gasoline, benzene, aldehydes, ketones and alcohols. Rods available from 0.100 to 2¾ in. diam. by 8-ft lengths. Strip is supplied in coil form in widths to 2¼ in. in all gages from 0.010 to 0.090-in. Material is used for bearings, gears, valve seats, washers, insulators, etc.

FM3001: Rod, strip and large cast tubing form. In black only. Lower strength, stiffness and hardness than FM10001; higher thermal expansion, lower moisture pick-up.

FM7001: Greenish-yellow rod, strip and cast tube sizes. Formulation of FM10001 and FM3001. For valve seats, spacing washers, and gaskets.

FE2031: Strip, slabs, large rods only. Plasticized 6501. Excellent impact strength; good abrasion resistance. Soft thrust washers, soft hammer heads, specialized industrial belting applications.

FE1044: Strip form only. Softest and most flexible of nylons. Does not contain plasticizer and does not oxidize and crack with age like rubber. For valve seats in hydraulic valves, fire extinguishers, packings in oxygen valves, industrial belting, etc.

POLYFLEX (Polystyrene plastics)—Plax Corp., Hartford 1, Conn.

Thermoplastic: Laminated continuous length rolls and laminated sheets for stamping and machining into parts; abrasion resistance, medium; resists corrosion caused by acids, alkalies and alcohol; max cont serv temp, 170 F; flexibility, medium; dielectric str, 500-3500 volts per mil; ts, 7000-10,000 psi; moisture absorp, low; shatterproof; sp gr, 1.052; transparent; machinability, good. For electronic parts, battery separators, placemats, etc.

POLYTHENE (Polyethylene plastics)—E. I. du Pont de Nemours & Co. Inc., Polychemicals Dept., Wilmington, Del.

Molding powder. Fabricated into machine parts by all types of molding, casting and extruding. Abrasion resistance, low; chemically resistant to water, acids, alkalies, oxygenated solvents; not resistant to chlorinated solvents, aromatic and aliphatic hydrocarbons; max cont serv temp, 140 F; dielectric str, 460 (volts per mil inst); ts, 1500 psi; in natural (waxy translucent white) and limited special colors; moisture absorp, 0.01; sp gr, 0.92; transparent in very thin layers; other, translucent; hardness (Durometer ASTM D676-44T), D45; useful for tubing, pipes, fittings, tank lining, and valve diaphragms.

POMPTON (Carbon tool steel)—Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

High quality carbon tool steel available from warehouse stocks in the general-purpose range C0.95-1.05. Suitable for arbors, bushings, lathe centers and other machine parts where a water-hardening tool steel is desired.

PORO-STONE (Ceramic)—R. P. Adams Co. Inc., Buffalo 17, N. Y.

Ceramic molded tubes having variable controlled pore size for filtration work. Ts, 3000 psi; max cont serv temp, 1000 C. subject to thermal shock; nonflammable; coef thermal exp'n, 5.7 x 10^{-6}. For filters.

POWDIRON (Porous iron bearing alloys)—Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.

Porous iron-bearing alloys and structural parts. All grades have high compressive strength.

61P: Contains no tin and only 10% copper and is impregnated with 25% of oil by volume. Stronger than other materials furnished by company, and recommended for heavy-duty, slower motion requirement where tensile strength is determining factor, as in aviation and ordnance industries. Ts, 30,000 psi; comp str, 140,000 psi.

55P: Contains no tin and only 5% copper. Used to conserve copper and tin. Ts, 12,000 psi; sp gr, 5.5; comp str, 140,000 psi; Oil by volume, 32%. Subject to corrosion under certain conditions, but due to protective film of oil will show less tendency to corrode than steel shaft.

59-I: Straight-iron material impregnated with 25% oil by volume. Recommended for parts other than bearings which may or may not be sized to close dimensions. Smooth mirror finished surface reduces friction. Ts, 12,000 psi; comp str, 130,000 psi.

Also produces machine parts to specification from iron and bronze powder metals.

POWER NICKEL-GENUINE (Babbitt) — Magnolia Metal Company, Elizabeth, N. J.

Hard tin-base babbitt for both high and low-speed bearings subject to sustained heavy pressures, high operating temperatures and moderate shock. 85% tin, lead-free; bhn, 27; ys, 10,800 psi; pouring temp, 900-1000 F.

PRECISION (Aluminum and zinc-base alloys)—Precision Castings Co. Inc., Syracuse, N. Y.

Type A-12: Aluminum base alloys. Si 12, Al balance. Max cont serv temp, 1000 F; ts, 33,000 psi; sp gr 2.666. For general aluminum die casting uses.

Type ZN-5: Zinc base alloy. Al 4, Cu 1, Mg 0.04, zinc, balance. Ts, 42,000 psi; comp str, 85,000; sp gr, 6.71; bhn, 75. For general die casting uses—automotive, washing machines, electrical equipment, etc.

A-50: Aluminum base alloy. Si 5, Al bal. Castings. Resists corrosion caused by atmosphere, foods, etc.; abrasion resistance, medium; ts, 29,000 psi; ductility, medium. For use where corrosion resistance and ductility are needed.

A-94: Aluminum base alloy. Si 8.5, Cu 3.5, Al bal. Ts, 38,000 psi; elong in 2 in., 2½%. Conforms to Federal Specification AXS-679, Rev. 3.

X-360: Aluminum-base die casting alloy. Si 10, Mg 0.5 Al bal. Not heat-treatable. Ts, 35,000 psi; elong in 2 in., 3.5%.

Al-218: Al. Not heat-treatable. Ts, 45,000 psi; elong in 2 in., 5%. Excellent resistance to corrosion.

PRECISION (Tubing and wire)—Precision Tube Co., Philadelphia 28.

Seamless tubing in nickel, nickel alloys, aluminum, copper, brass, and bronze. For machining, cold working, drawing, brazing and plating. Hardnesses to specification. For vacuum tube parts, air restriction tubing temperature, pressure control apparatus and instrument pointers.

Precision metal shielded wire; copper, brass, aluminum or nickel, tubing around virtually any dielectric and inner conductor. For machining and cold working; weldability, good; max cont serv temp depends on dielectric strength. For electronic equipment, sound systems, shielding conductors in corrosive atmospheres, shielded wires, radio components.

PREG-TECH (Impregnated Wood) — Technical Ply-Woods, Chicago 1.

Thermosetting: Sheet form for machining into parts. Abrasion resistance, good; resists corrosion, repels termites; heat resistance, good; bonded at 350 F; flexibility, medium to low depending on thickness; ts and comp str, good to excellent depending on thickness; moisture resistance, excellent; machinability, good.

PRESDWOOD (Wood-fiber panels) — Masonite Corp., Chicago.

Wood fiber board in sheets ⅛, 3/16, ¼, 5/16-inch thick, max size 4 x 12 ft, for machining into parts. Abrasion resistance, medium; chemical resistance, good to fairly weak solutions; max cont serv temp, 300 F; flexibility, low; ts, 3200 psi; comp str, 16,500 psi; trans str, 5900 psi; moisture absorp, low; in natural brown; opaque; shatterproof; sp gr 1.02; machinability, good. For various industrial uses. This material is also available in "Tempered" and Duolux grades.

PRESSUREDIE (High alloy steels)—Braeburn Alloy Steel Corp., Braeburn, Pa.

No. 2: High alloy steel containing C 0.35, Si 0.90, Cr 5.00, V 0.20, Mo 1.40, and W 1.10. Rough bars or billets, finished rods or bars, for machining. Recommended heat treatment: 1825 F air cool, draw 1050-1150 F. Properties, heat-treated: Ts, 250,000 psi; ys, 200,000 psi; bhn, 417-514. For extrusion cies, extrusion press rams and liners etc.

No. 3: C 0.39, Si 1.00, Cr 5.50, V 1.00, Mo 1.10. Rough bars or billets, finished rods or bars. Recommended heat treatment: Heat to 1825 F, air cool, then draw to 1080-1100 F. Bhn, 444-477; machinability good. For aluminum die-casting dies.

PROMAL (Malleable iron)—Link-Belt Co., Indianapolis 6.

Specially processed malleable iron having high yield and fatigue strengths; for resistance to mild corrosive attack can be furnished with copper content; can be hot-dip galvanized without embrittlement and can be used in ovens and furnaces up to 1100 F. Uses include conveyor and drive chain links, bearing caps, rocker arms, sheaves, levers and other parts subjected to severe service.

PROMET (Bearing Bronzes) — The American Crucible Products Co., Lorain, O.

No. 1: Nominal composition: Cu 67.5, Sn 2.00, Pb 30.00, Ni 0.50. Sand castings. Properties, as cast: Ts, 18,000 psi; compr str, 6000 psi; ys, 11,000 psi; elong in 2 in., 14%; bhn, 30-40; nonmagnetic; machinability, good; weldability, good; resistant to most acids and alkalies, refrigerants and brines. For light-pressure bearings at all speeds; useful where lubrication is faulty or difficult to maintain.

No. 2-S: Nominal composition: Cu 71.50, Sn 5.00, Pb 23.00, Ni 0.50. Sand castings. Properties, as cast: Ts, 23,000 psi; compr str, 8250 psi; ys, 14,000 psi; elong in 2 in., 15%; bhn, 40-50; nonmagnetic; machinability, good; weldability, good; resists most acids and alkalies, also refrigerants. Will stand up under dust and abrasive conditions without scoring. For locomotive journal bearings and similar parts.

No. 6: Nominal composition: Cu 77.50, Sn 6.00, Pb 15.00, Ni 1.50. Sand castings. Properties, as cast: Ts, 33,000 psi; compr str, 14,000 psi; ys, 20,000 psi; elong in 2 in., 12%; bhn, 60-70; nonmagnetic; resists corrosion by most acids and alkalies; machinability, good; weldability, good. For heavy-duty bearings, worms and worm gears.

No. 6-SK: Nominal composition: Cu 76.50, Sn 7.00, Pb 15.00, Ni 1.50. Sand castings. Properties, as cast: Ts, 36,000 psi; compr str, 15,000 psi; ys, 23,000 psi; elong in 2 in., 15%; bhn, 60-70; nonmagnetic; resists corrosion by most acids and alkalies; machinability, good; weldability, good. For heavy-duty bearings and equipment such as mining machines.

No. 18: Nominal composition: Cu 78.50, Sn 5.00, Pb 15.00, Ni 1.50. Sand castings. Properties, as cast: Ts, 30,000 psi; compr str, 12,000 psi; ys, 18,000 psi; elong in 2 in., 16%; bhn, 50-60; nonmagnetic; resists corrosion by most acids and alkalies; machinability, good; weldability, good. For medium-pressure bearings at all speeds, locomotive axle liners, seals, etc.

No. 89-S: Nominal composition: Cu 88.50, Sn 8.00, Pb 3.00, Ni 0.50. Sand castings. Properties, as cast: Ts, 35,000 psi; compr str, 16,000 psi; ys, 20,000 psi; elong in 2 in., 16%; bhn, 70-80; nonmagnetic; good resistance to most acids and alkalies; machinability, good; weldability, good. For bearings subject to extra heavy duty at medium to low speeds; for straight and helical tooth gears, etc.

No. 91-SK: Nominal composition: Cu 86.00, Sn 9.50, Pb 2.00, Ni 1.50. Sand castings. Properties, as cast: Ts, 48,000 psi; compr str, 17,000 psi; ys, 24,000 psi; elong in 2 in., 25%; bhn, 70-80; nonmagnetic; good resistance to corrosion by most acids and alkalies; machinability, good; weldability, good. For extreme heavy-duty bearings and for gears, worms, bolts, nuts, etc.

PSF (Steels)—Pittsburgh Steel Foundry Corp., Glassport, Pa.

Steel castings up to the largest in carbon or alloy steels and Pitaloy. For railroad and marine industries; also for other types of machines.

PSI (Steels)—Peterson Steels Inc., Newark, N. J.

No. 1: C 0.92-1.02, Mn 0.95-1.25, Si 0.50-0.70, P 0.025 max, Cr 0.90-1.15, S 0.025 max, Ni 0.35 max, Cu 0.25 max, Mo 0.08 max. Rough bars or billets, finished rods or bars, forgings, and tubing, for machining. Abrasion resistance and ts, high. For ball and roller bearings, bushings, thrust collars, spindles, hardened sleeves, clutch liners and faces, knives, etc.

No. 2: C 0.87-0.97, Mn 1.40-1.70, Si 0.60-0.80, P 0.025 max, S 0.025 max, Cr 1.40-1.70, Ni 0.35 max, Cu 0.25 max, Mo 0.08 max. Ingots and rods or bars, forgings and tubing, for machining. Abrasion resistance and ts, high; bearing qualities good. For ball and roller bearings, bushing, spindles, collars, hardened sleeves, clutch liners and faces, etc.

PUREBON (Carbon graphite)—Pure Carbon Co., Inc., St. Marys, Pa.

Available in 23 different grades having following property ranges: Scleroscope hardness, 40-90; trans str, 4500-13,000 psi; coef. of linear expansion, 1.2-12.1 x 10^{-6}; max safe oper temp, 375-800 F. Material is self-lubricating and nonseizing against metallic surfaces; is not corrosive; dimensionally stable; readily machined; readily molded; used for seal rings, bearings, piston and piston rings, pump vanes, gears and plates, high-temperature molds, stuffing box seals, etc. Can be copper-coated for soldering to metals; can be cemented or vulcanized to rubber; can be cemented to metal.

PUREMET (Metal powder)—Pure Carbon Co. Inc., St. Marys, Pa.

Supplied in various combinations of copper, tin, zinc, iron, steel, and graphite. Self-lubricating noncorrosive. Parts made from this powder can be threaded, tapped, drilled, reamed, etc., readily. For seal rings, bearings, cams, gears, guide bushings, etc.

PURPLE STRAND (Wire rope) — Bethlehem Steel Co., Bethlehem, Pa.

Wire rope, improved plow steel grade.

PYRALIN (Cellulose nitrate plastic)—E. I. du

Pont de Nemours & Co., Inc., Polychemicals Dept., Wilmington, Del.

Nitrocellulose base thermoplastic. Sheets, rods and tubes for machining into parts. Swaged, die-pressed and machined parts offer abrasion resistance, are unaffected by weak acids, but decomposed by strong acids; gradually decomposed by alkalies and soluble in alcohols and esters. Max cont serv temp, 170-185 F at 66 psi; flex str, 6000-15,000 psi (ASTM D 650-42T); dielectric str, 250-500 volts per mil; ts, 3-8000 psi; compr str, 20-30,000 psi; impact str, 5-9 ft lb (Izod); in colors; moisture absorp, low; sp gr, 1.33-1.6; transparent, translucent and opaque; machinability, good. For handles, gage glasses, instrument covers, etc.

PYRAMID (Babbitt)—Magnolia Metal Company, Elizabeth, N. J.

Hard, lead-base alloy for use in place of hard genuine babbitt in even-speed bearings subject to heavy pressure and high local temperature. 80% lead, copper-free; bhn, 24; ys, 8,875 psi; pouring temp, 875-1000 F.

PYRASTEEL (Alloy steel castings) — Chicago Steel Foundry Co., Chicago 32.

Ni varies from 8% up, Cr from 8.26%; available as castings for heat-treating furnaces, screw conveyors, or any high-temperature service to 2200 F. Also available in following grades:

No. 14: Cr 6, Mo 5.

No. 18: Ni 25, Cr 16.

No. 20: Ni 35, Cr 18.

No. 2000: Cr 26-28, Ni 12-14.

All of these grades carry a high silicon content, varying from 1-2.5%.

PYREX (Glasses)—Corning Glass Works, Corning, N. Y.

In general, glasses with coefficient of expansion ranging from 20 to 50 x 10^{-7} C. Blown, drawn, pressed products with wide range of chemical, physical, optical, electrical and mechanical properties.

PYTHON (Water-hardening steel) — Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

C 0.85, V 0.25. For chuck jaws, clutch pins and other parts requiring unusual wear and shock resistance. Water hardening.

RACO (Welding electrodes) — Reid-Avery Co. Inc., Dundalk, Baltimore 22, Md.

A series of heavily coated electrodes conforming to AWS Types E-6010, E-6011, E-6012, E-6013, E-6020, E-6030, E-7010, E-8010, E-9010, E-10010, E-7011, E-8011, E-9011, E-10011, E-7020, E-8020, E-9020, and E-10020.

RACOLLOY (Stainless steel electrodes)—Reid-Avery Co. Inc., Dundalk, Baltimore 22, Md.

A series of stainless steel electrodes conforming to AISI Types 308, 347, 316, 317, 316+Cb, 309, 309+Cb, 310, 310+Mo, 310+Cb, 307, 430, 330, and 502.

RADIO CORES (Powder metals)—Radio Cores Inc., Oak Lawn, Ill.

RC101: Pure copper powder-metal parts pressed and sintered to specification. Density, 0.299 lb per cu in.; ts, 25,000 psi; ys, 18,000 psi; Rock hdns, H45; sp gr, 8.2 with density of 0.322 lb per cu in.; ts, 30,000 psi; ys, 22,000 psi; Rock hdns, H55; sp gr, 8.9. Latter material has 96% electrical conductivity. For shading coils and other electrical parts.

RC102A: Free machining brass alloy in pressed and sintered parts to specification. Ts, 28,000 psi; ys, 18,000 psi; elongation 13%; sp gr, 7.91. For gears, hardware parts, hubs, lock parts, clock parts, connectors, relays and brush holders.

RC104: Pure iron powder parts pressed and sintered to specification. Ts, 35,000 psi; ys, 20,000 psi; Rock hdns, H50; sp gr, 6.90; magnetic. For low cost machine parts.

RC105: Cu 0.80, Fe balance, plus 1% max imp. Pressed and sintered parts to specification. Ts, 50,000 psi; ys, 35,000 psi; Rock hdns, C18; sp gr, 6.85. For medium-strength low-cost machine parts such as cams, pawls, low-load gears, etc.

RC106: Pressed and sintered parts to specification. Fe 90, Cu 10. Ts, 50,000 psi; ys, 45,000 psi. Rock hdns, H75, sp gr, 7.20. For cams, gears, structural parts, die parts with greater strength than RC104.

RC107: Pressed and sintered parts to specification. Fe 75, Cu 25. Ts, 60,000 psi; ys, 45,000 psi. Rock hdns, H75, sp gr, 7.20. For same parts as RC104 and RC106 where maximum strength is required at slightly higher cost.

RC108: Pressed and sintered parts to specification. Sp gr, 7.86; coercive force. Hc. in oersted 250; residual induction Br. in gauss 10,500; Rock hdns, C50; permanent magnet; low cost; replaces 36% cobalt steel. Used in thermostats, meters and various instruments.

RC109: Pressed and sintered parts to specification. Fe 100%; ts, 45,000 psi; ys, 23,000 psi; Rock hdns, H60; sp gr, 7.4. For electrical uses such as pole pieces.

RC110: For oil impregnated bearings to specification. 20% porosity; ts, 15,000 psi; ys, 8,000 psi; Rock hdns, H25; sp gr, 6.8.

RAILFACE (Welding electrodes) — American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

C 0.5, Cr 1.5, Mo 0.2. Bhn, 325-350. Abrasion and impact resistant. For building up carbon steel frogs, crossings, and rail-ends.

RANDALL (Bronze)—Randall Graphite Bearings Inc., Chicago.

Bronze bars by radial die-cast method. Standard 664 alloy: Cu 80.0-83.0, Sn 7.0-9.0, Pb 7.0-9.0, Zn 1.0-2.0. Properties: Ts, 35,000 psi; ys, 22,000 psi; elong in 2 in., 20%; bhn, 70. For bearings and bushings.

RANIER (Ferro alloys) — Ohio Ferro Alloys Corp., Canton, Ohio.

Ferro alloys for deoxidizing agents and for alloying in the production of iron and steel.

RANITE (Hardsurfacing electrodes) — Rankin Mfg. Co., Los Angeles 6.

Ranite "A": Arc rod; metallic coating; forgeable; ac-dc; all position. For extreme impact, angular shock. Good build-up under harder deposits. Limited machinability with preheat.

Ranite "B": Arc rod; metallic coating; forgeable; ac-dc; all position. Where toughness and hardness are factors. Ductility against great impact; resistant to average abrasion.

Ranite "C": Arc rod; metallic coating; forgeable; ac-dc; all position. Good flexibility in relation to hardness; excellent wear on applications of moderate impact and severe abrasion.

Ranite "D": Arc rod; metallic coating; forgeable; d-c recommended. For extreme abrasion.

Ranite "4": Uncoated acetylene rod; flat position. Thin, smooth scouring overlay. Rock hdns, 45C at 800 F.

Castweld: Arc rod; metallic coating; ac-dc; reverse polarity, all position. +99% Nickel core wire. Strong welds on cast iron.

Ranmang: Arc rod; ac-dc; coated. Recommended for working on manganese parts.

RAYDUCT (Butt-welded steel pipe)—Bethlehem Steel Co., Bethlehem, Pa.

High ductility; used for radiant heating installations.

RAZOrSEAL (Felt gasketing)—Stratocote, Inc., Los Angeles 1.

A felt-base gasketing composition supplied in rolls and tapes; in colors blue and gray; does not fatigue or harden with age.

REANITE (Plastics bonding resin) — United States Stoneware Co., Akron 9.

Resinous base, thermosetting material: Liquid form, for bonding metals to metals or rubber to plastics to metals. Abrasion resistance, medium; resists corrosion caused by acids and alkalies; max cont serv temp, 300 F; flexibility, high; ts, 3000 psi; moisture absorp, low; shatter-proof; in black only; opaque.

RED ANCHOR (Drill rods) — Anchor Drawn Steel Co., Latrobe, Pa.

C 0.95-1.1. Commercial carbon drill rods. Strength varies from 70,000 psi; annealed, to 225,000 psi, fully hardened; reduction in area when annealed, as high as 50%. For precision shafts for motors, spindles, anvils, tools, dies, etc.

RED CIRCLE (Alloy tool steel)—Amalgamated Steel Corp., Cleveland 5, O.

Special analysis tool steel. Rough bars or billets, finished rods or bars, and special forgings. Properties, unheat-treated: Ts, 140,000 psi; ys, 123,000 psi; elong in 2 in., 17%; magnetic; machinability, good; weldability, good; abrasion resistance, high. Combines toughness with ease of machining and heat treatment. For gears, cams, shafts, collets, wrist pins, shackles, etc.

RED-CUT SUPERIOR (High-speed steel) — Vanadium Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

C 0.50, 0.60 and 0.70, W 18, Cr 4.00, V 1.00, Si 0.25, and Mn 0.25. Rough bars or billets, finished rods or bars, wire, sheet, plate, forgings and drill rods, for machining, hot and cold working, stamping, drawing and brazing. Properties, heat-treated: Imp str (charpy), 30 ft-lb unnotched; Rock hdns, C 67 max; sp gr, 8.67; magnetic; max cont serv temp 1200 F; abrasion resistance, high. For high temperature springs, etc.

REDHARD NF (Casting alloy)—Redhard Metals Inc., Glenside, Pa.

Co 45.2, Cr 32.2, W 18.1, C 2.4. For precision castings. No heat treatment required. Ts, 73,000 psi; Rock hdns, C62-63; machinability, poor; resists most acids, weather etc.; abrasion resistance, high; max cont serv temp. 2300 F. For parts that require precision casting, where abrasion resistance is needed.

RED STREAK (Molybdenum-type tool steel)—Simonds Saw & Steel Co., Fitchburg, Mass.

Supplied as flat ground stock. Finish, 25-35 micro-inches; wide hardening range, nondeforming. Supplied in thicknesses of 1/64 to 1 in. For machine parts such as levers, links, pawls, spinnets, cams, rollers, keys, etc.

Ground die steel: Molybdenum type, nondeforming; oil hardening. Supplied in 18-in. long bars, in thicknesses ranging from ⅛ to 1¼ in. For making dies and a variety of machine parts such as cams, cam rolls, pawls, links, levers, spinnets, etc.

RED-X (Aluminum alloys)—Apex Smelting Co., Cleveland 5, and Chicago 12.

No. 5: Nominal composition: Si 5.5, Cu 1.5, Mg 0.3, Mn 0.3. Ingots, for sand, permanent-mold, die, precision castings and forgings. Properties, variously heat-treated: Ts, 29-48,000 psi; ys, 18-20,000 psi; elong, 1-7%; bhn, 70-105. Endurance limit 10,000 psi at 100 million; sp gr, 2.70; nonmagnetic; weldability, good; max cont serv temp, 300 F. Machinability, good. Used for aircraft castings such as superchargers, pump housings, carburetors, engine and motor castings such as cylinder heads, blocks, crankcases, housings, etc., and intricate castings requiring pressure tightness.

No. 8: Nominal composition: Si 8.0, Cu 1.5, Mg 0.3, Mn 0.3. Ingots for sand, permanent-mold, die, precision castings and forgings. Properties, variously heat-treated: Ts, 28-49,000 psi; ys, 18-42,000 psi; elong, 1-6%; bhn, 70-105; sp gr, 2.70; nonmagnetic; weldability, good; max cont serv temp, 350 F. Many variations of properties obtainable by application of different heat treatments. Has good casting and machining characteristics. Used for aircraft castings, such as surperchargers, pump housings, carburetors, engine and motor castings, such as cylinder heads, blocks, crankcases, housings, and intricate castings requiring pressure tightness.

No. 10: Nominal composition: Si 10, Cu 1.5, Mg 0.5, Mn 0.5. Ingots for sand, permanent-mold, die castings, forgings. Properties, heat treated (permanent mold): Ts, 40,000 psi; ys, 30,000 psi; elong, 1.0; bhn, 95; sp gr, 2.69; nonmagnetic; max cont serv temp, 400 F. For diesel, automotive, and small engine pistons and similar bearing parts because of its high strength and low coefficient of thermal expansion, and good abrasion resistance.

No. 13: Nominal composition: Si 13, Cu 1.5, Mg 0.5, Mn 0.5. Ingots for permanent-mold and die castings. Properties, heat treated (permanent mold): Ts, 40,000 psi; ys, 30,000 psi; bhn, 95; sp gr, 2.69; nonmagnetic; max cont serv temp, 400 F. Uses same as Red X-10; lower coefficient of thermal expansion and better abrasion resistance.

REFRACTALOY 26 (Heat-resistant alloy) — Westinghouse Electric Corp., East Pittsburgh, Pa.

Ni 37, Co 20, Cr 18, Ti 3.0, Mo 3.0, Fe 15. Rough bars or billets, rods or bars, wire, strip, and plates. For hot forging, stamping, turning, boring, welding. Resists corrosion caused by atmosphere and salt solution; resists heat to 1450 F; nonmagnetic; ts, 150,000 bhn, 241-375 (depends upon heat treatment). For applications where high strength at high temperatures is required.

REFRASIL (High-temperature insulating material)—The H. I. Thompson Co., Los Angeles 7.

High-silica-content all mineral insulation. Max cont serv temp, 2000 F; chemically stable; available in batts, cloth, tapes, sleeving, cordage, loose fiber, and in prefabricated blankets. For insulation of high temperature power equipment, hot gas duct insulation, filtration of gases at high temperatures, covering of high-temperature thermocouple lead wires, protection of electrical wire and equipment against heat, flame, and grounding; acoustical insulation at high temperatures; insulation of electric muffle furnace.

REPUBLIC ALDECOR (High-strength steel)—Republic Steel Corp., Cleveland 1, Ohio

A low-carbon high-strength steel containing copper, silicone, phosphorus and molybdenum. Produced in sheets, strip, plates and bars; ts 70,000 psi min; yp 50,000 psi min; elong. in 2 in., 22% min; high resistance to atmospheric corrosion; good welding and workability; medium abrasion resistance. For decreased dead weight at decreased cross-section or increased durability at the same cross section.

REPUBLIC COR-TEN (High-strength steel) — Republic Steel Corp., Cleveland 1, Ohio

A low-carbon high-strength steel containing copper, silicone, phosphorus, chromium and nickel. Produced in sheets, strip, plates and bars; ts 70,000 psi min; yp 50,000 psi min; elong in 2 in., 22%; high resistance to atmospheric corrosion; good welding and workability; medium abrasion resistance. For decreased dead weight at decreased cross section or increased durability at the same cross-section.

REPUBLIC DOUBLE STRENGTH (High-strength steel)—Republic Steel Corp., Cleveland 1, Ohio

A low-carbon high-strength steel containing copper, nickel and molybdenum. Produced in sheets, strip, plates and bars; ts 70,000 psi min; yp 50,000 psi min; elong. in 2 in., 22% min; high resistance to atmospheric corrsion; good welding and workability; medium abrasion reistance. For decreased dead weight at decreased cross section or decreased durability.

REPUBLIC N. E. S. 70 (High-strength steel)—Republic Steel Corp., Cleveland 1, Ohio.

A low carbon high strength steel containing nickel, copper, and molybdenum added to a 0.10/0.20 carbon steel. Produced in sheets, strip and bars; ts 60,000 to 80,000 psi after stress relieving; elong in 2 in. varying with physical properties; good welding and shock resistance at low temperature. For decreased dead weight at decreased cross section or increased durability at the same cross section.

RESILION (Thermoplastic plastics) — United States Stoneware Co., Akron 9.

Resinous thermoplastics: Sheets and lumps to be molded and cast into machine parts. Corrosion-resistant; flexible; dielectric str, high. Used for lining parts to resist corrosive attack.

RESIMENE (Melamine plastic molding compound) — Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Particularly suitable for compression and transfer molding; widely used in automatic molding machines. Strength properties comparable to phenolics. Resistance to alkalies much better than other compression materials; excellent resistance to oils, greases, petroleum derivatives, alcohol, organic solvents and weak acids. Good electrical insulating properties particularly where arc resistance or nontracking is a factor. Color range, light to dark translucents and opaques.

RESIN X-2 (Adhesive) — Furane Plastics & Chemicals Co., Glendale 4, Calif.

Furane thermosetting plastic adhesive. Particularly adapted to bonding thermosetting plastics and ceramic materials. Sets at room temperature; has high shear strength.

RESINOX (Phenolic molding plastics) — Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Standard and special formulas. Thermosetting; heat-resistant; sp gr, 1.25-1.75; flexural str, 8000-15,000 psi; ts, 4200-8000 psi; impact str, (Izod), 0.2-8.00 ft-lb; water absorp, 0.01-0.6% (immersion 48 hours). Used in electrical equipment, large housings, radio cabinets, etc. Tradename also refers to phenolic impregnating and treating resins.

RESISTAC (Aluminum bronze) — American Manganese Bronze Co., Philadelphia 36, Pa.

Three grades of aluminum bronze: Sand castings, rods or bars and hammered forgings; strong; light. Resist certain acids and chemicals; retain strength at high temperatures; excellent fatigue values. Compositions and physical characteristics for all grades are given below:

Nos. 1 and 2: Cu 85-90, Al 8-11, Fe 4 max. Ts, untreated, 65-80,000 psi; ys, 28-35,000 psi; elong in 2 in., 20-30%; impact resistance, medium; bhn, 120-150; nonmagnetic; weldability, fair; max cont serv temp, 500 F; abrasion resistance, medium. Used for parts requiring high corrosion resistance, strength, and heat resistance, such as mill and valve guides; and for parts requiring good fatigue resistance.

No. 3: Cu 80 min, Al 8-10, Fe 5 max, Ni 5 max. Can be heat-treated by quenching from 1600 F, drawn at 700-1000 F, increasing strength and hardness but lowering ductility. Properties, untreated: Ts, 90,000 psi min; ys, 42,000 psi; elong in 2 in., 15%; impact resistance, medium; bhn, 185 min; practically nonmagnetic; weldability, fair. Max cont serv temp, 500 F; abrasion resistance, low. For parts requiring high corrosion resistance and strength, such as gears, guides, etc.

RESISTALOY (Aluminum-nickel yellow brass)—Titan Metal Mfg. Co., Bellefonte, Pa.

Cu 59, Al 2.00, Ni 1.00, Zn balance. Properties, cold-drawn: Ts, 95,000 psi; ys, 58,000 psi; Rock hdns, B90. Exceptionally resistant to corrosion by sea water. For shafts, special bearings, forgings, bolts, nuts, studs, etc., on marine equipment.

RESISTOFELT (Laminated felt and Neoprene)—Western Felt Works, Chicago.

Used on revolving shafts; felt lubricates the shaft and prevents entrance of dust; Neoprene prevents passage of oil.

RESISTOFLEX (Elastomer)—Resistoflex Corp., Belleville, N. J.

Synthetic resin base: Sheet and laminated form, and in rods, hose and tubes; abrasion resistance, high; impervious to oils, gasoline and organic solvents; max cont serv temp, 250 F; flexibility high; dielectric str, 10.7 (volts per mil inst); ts, 5236 psi; moisture absorp, medium; sp gr, 1.259. For diaphragms, gaskets, oil, hydraulic, fuel, refrigeration, lubricating, industrial spray finishing and solvent handling hose assemblies and molded parts.

RESISTRESS (Alloy steel castings)—Reliance Steel Casting Co., Pittsburgh.

Mn-Ni-V steel castings to specification. Properties, double normalized and tempered: Ts, 90,000 psi; ys, 60,000 psi; elong in 2 in., 25%; bhn, 180. For machine parts subject to high stress and impact.

RESISTWEAR (Welding electrodes)—American Manganese Steel Div. of American Brake Shoe Co. Chicago Heights, Ill.

C 0.6, Cr 6.0, Mo 0.5. Bhn, 400-500. Abrasion and impact resistant up to 600 F. For hardfacing only; martensitic steel deposits; magnetic; abrasion and impact resistant. For hardfacing ferrous parts subject to extreme wear.

RESPROID (Vinyl plastic)—Respro Inc., Cranston 10, R. I.

Furnished in rolls.

REVERE (Brasses) — Revere Copper & Brass Inc., New York 17.

Alloy No. 110: Gilding brass. Compared to copper this alloy has higher tensile strength, equal ductility, lower thermal properties. Properties, depending on hardness: Ts, 34-56,000 psi; ys, 10-50,000 psi; elong in 2 in., 45-5%; Rock hdns, F46-B64; produced to ASTM specifications. Makes excellent base for articles to be gold plated, high polished or enameled.

Alloy No. 120: Commercial bronze. Sheet, strip, plate, tube and forgings. Properties, depending on hardness: Ts, 37-61,000 psi; ys, 10-55,000 psi; elong in 2 in., 50-5%; Rock hdns, F53-B70; produced to ASTM specifications. Cold and hot working properties, excellent; machinability, poor; very ductile. Excellent for soldering and polishing. For forgings, screws, weather stripping, stamped hardware.

Alloy No. 130: Red brass. Higher strength and better ductility than copper. Corrosion resistance often exceeds that of copper; more successful at high temperature than higher zinc alloy. Properties, depending on hardness: Ts, 40-70,000 psi; ys, 10-58,000 psi; elong in 2 in., 55-5%; Rock hdns, F55-B77; conforms to ASTM specifications. Cold working properties, excellent; hot working properties, good; machinability, poor. Excellent for soldering and polishing. For dials, hardware, etched parts, automobile radiators, tube and pipe for oil and utility fields and plumbing.

Alloy No. 140: Low brass. Properties and qualities closely similar to those of Alloy No. 130.

Alloy No. 160: Cartridge brass. Best combination of ductility and strength of any brass. Ts, 47-78,000 psi; ys, 15-64,000 psi; elong in 2 in., 65-8%; Rock hdns, F64-B82; conforms to ASTM specifications. Cold working properties, excellent; hot working properties, good; machinability, fair. Excellent for soldering and polishing. For deep drawing, spinning, etching, rolling and for practically all fabricating processes. Parts include pins, rivets, eyelets, auto radiator cores, heating units, lamp bodies and reflectors, cartridge cases and clips, electrical sockets, etc.

Alloy No. 170: Yellow brass. Strip, wire and lock seam tubing. Properties, depending on hardness: Ts, 47-74,000 psi; ys, 15-60,000 psi; elong in 2 in., 65-8%; Rock hdns, F64-B80; conforms to ASTM specifications. Cold working properties, excellent; hot working properties, poor; machinability, fair. Excellent for soldering and polishing. Uses similar to Alloy No. 160.

Alloy No. 180: Muntz metal. Sheet, rod, tube, forgings, extruded shapes. Properties, depending on hardness: Ts, 54-80,000 psi; ys, 21-60,000 psi; elong in 2 in., 50-10%; Rock hdns, F80-B85; conforms to ASTM specification. Cold working properties, fair; hot working properties, excellent; machinability, good; ductility, high. Excellent for soldering and polishing. For condenser tubes, valve stems, brazing rods, etc.

Alloy No. 224: Low-leaded brass tubing. Free machining combined with moderate cold forming ability. Properties, depending on hardness: Ts, 47-75,000 psi; ys, 15-60,000 psi; elong in 2 in., 60-7%; Rock hdns, F64-B80; conforms to ASTM specifications. Cold working properties, fair; hot working properties, poor; machinability, good; weldability, poor. Excellent for soldering and polishing. For screw machine parts, electrical fuse parts, for pipes, pump liners, etc.

Alloy No. 235: High-leaded brass—sheet and strip. Free machining and good blanking properties. Properties, depending on hardness: Ts, 49-74,000 psi; ys, 17-60,000 psi; elong in 2 in., 52-7%; Rock hdns, F68-B80. Cold and hot working properties, poor; machinability, excellent; weldability, poor. Excellent for soldering and polishing. For engraving plates, nameplates, keys, lock parts, tumblers, gears, parts for watches.

Alloy No. 240: Free-cutting brass rod. Excellent machinability combined with good mechanical and corrosion resisting properties. Properties, depending on hardness: Ts, 49-58,000 psi; ys, 18-45,000 psi; elong in 2 in., 53-25%; Rock hdns, F68-B78; conforms to ASTM specifications. Poor cold working properties, good hot working properties, excellent machinability, poor weldability, good for soldering, excellent for polishing. For screw machine parts and other parts requiring free-cutting properties.

Alloy No. 280: Forging brass. Combines good corrosion resistance with excellent mechanical properties; fair cold working properties, excellent hot working properties, good machinability, poor weldability, good for soldering and excellent for polishing. For hot forgings, hardware and plumbing goods.

Alloy No. 283: Architectural bronze. Excellent forging and free machining properties. Very poor for cold working, excellent for hot working, poor weldability, excellent for soldering and polishing. For handrails, decorative moldings, grilles, revolving door parts, miscellaneous architectural trim, industrial extruded shapes such as hinges, lock bodies, automotive parts, etc.

Alloy No. 340: Chain bronze. Good combination of strength and ductility. Properties depending on hardness: Ts, 45-67,000 psi; ys, 12-50,000 psi; elong in 2 in., 45-5%; Rock hdns, F60-B80; good cold working properties, fair hot working properties, poor machinability, excellent for soldering and polishing. For sash chain and other similar chains.

Alloy No. 358: Admiralty. Excellent corrosion resistance combined with strength and ductility. Properties, depending on hardness: Ts, 50-100,000 psi; ys, 18-80,000 psi; elong in 2 in., 65-3%; Rock hdns, B25-95; conforms to ASTM specifications. Good cold working properties, poor hot working properties, fair machinability, weldable by gas and carbon arc, good soldering and polishing characteristics. For condenser and heat exchanger plates and tubes, chemical and process equipment, various marine uses, automobile materials, etc.

Alloy No. 380: Roman bronze. High resistance to fatigue and salt water corrosion. Properties, depending on hardness: Ts, 60-82,000 psi; ys, 22-55,000 psi; elong in 2 in., 45-20%; Rock hdns, B50-80; conforms to ASTM specifications. Fair cold working properties, excellent hot working properties, good machinability, excellent for soldering and polishing. For propeller and pump shafts, piston rods and a variety of marine uses.

Alloy No. 386: Naval brass. Good resistance to salt water corrosion and is satisfactory for moderate cold working operations. Properties, depending on hardness: Ts, 57-90,000 psi; ys, 20-70,000 psi; elong in 2 in., 47-5%; Rock hdns, B45-95; conforms to ASTM specifications; has fair cold working properties, excellent hot working properties, good machinability and excellent for soldering and polishing. For tube sheets, heat exchangers and steam condensers and for hot worked forgings.

Alloy No. 389: Leaded naval brass. Similar to Alloy No. 240 but has increased strength and corrosion resistance. Properties, depending on hardness: Ts, 57-90,000 psi; ys, 20-70,000 psi; elong in 2 in., 40-5%; Rock hdns, B45-90; conforms to ASTM specifications. Has poor cold working properties, good hot working properties, excellent machinability, poor weldability and good soldering and polishing characteristics. For screw machine products, marine hardware, forgings, bolts, etc.

Alloy No. 454: Manganese bronze. High strength combined with excellent wear resistance. Properties, depending on hardness: Ts, 65-84,000 psi; ys, 30-60,000 psi; elong in 2 in., 33-19%; Rock hdns, B65-90; conforms to ASTM specifications. Poor cold working properties, excellent hot working properties, good machinability; excellent for soldering and polishing. For forgings, condenser plates, valve stems, coal screens, etc.

Alloy No. 435: Aluminum brass. Excellent corrosion resistance combined with good strength and ductility. Physical properties depending on hardness: Ts, 60-85,000 psi; ys, 27-60,000 psi; elong in 2 in., 55-10%; hardness, Rock 77F-86B; conforms to ASTM specifications. Has good cold working properties, fair hot working properties, poor machinability and is excellent for soldering. Used for condenser and heat exchanger tubes, steam power plant equipment, chemical and process equipment, and various marine uses.

REVERE (Bronzes)—Revere Copper & Brass Inc., New York 17.

Alloy No. 429: Aluminum bronze condenser tube alloy. Properties: Ts, 50-70,000 psi; elong in 2 in., 64-25%; Rock hdns, F55-B80; conforms to ASTM specifications. Cold working properties, good; hot working properties, good; machinability, fair; weldability, good; resistance to acids, high. Good for soldering and polishing. For condenser tubes, high strength forgings, tie bolts, hardware bushings, etc.

Alloy No. 436: Aluminum-silicon Bronze. Unusually high tensile strength, excellent corrosion resistance, readily hot forged, rolled and extruded, and free-machining. Properties depending on hardness: Ts, 85-95,000 psi; ys, 43-53,000 psi; elong in 2 in., 35-25%; conforms to ASTM specifications. For bolts, nuts, gears, pinions, valve bushings, valve bodies and stems, marine hardware, etc.

Alloy No. 308: Phosphor Bronze. Properties, depending upon hardness: Ts, 47-81,000 psi; ys, 19-75,000 psi; elong in 2 in., 64-10%; Rock hdns, F73-B87; corrosion resistance, high; coef friction, low; immunity to season cracking, high; conforms to ASTM specifications. Used for diaphragms, bellows, lock washers, cotter pins, fuse clips, clutch disks, springs, screw machine stock, etc.

Alloy No. 315: Phosphor Bronze. Properties, depending on hardness: Ts, 55-93,000 psi; elong in 2 in., 70-10%; Rock hdns, F75-B93; corrosion resistance, high; fatigue resistance, high; coef friction, low; conforms to ASTM specifications. Cold working properties, excellent; hot working properties, poor; machinability, fair; weldability, good. Excellent for soldering and polishing. For springs, perforated sheets, bellows, cotter pins, fuse clips, bushings, lock washers, etc.

Alloy No. 325: Bearing Bronze. Properties, depending on hardness: Ts, 45-65,000 psi; ys, 10-57,000 psi; elong in 2 in., 42-5%; Rock hdns, F55-B76; cold and hot working properties, excellent; machinability, fair; weldability, good. Excellent for soldering and polishing, bushing material for light loads, weatherstrip applications, fuse clips, lamp connections, etc.

REVERE (Coppers)—Revere Copper & Brass Inc., New York 17.

Alloy No. 100: Properties, depending upon hardness: Ts, 32-55,000 psi; ys, 8-50,000 psi; elong in 2 in., 55-6%; Rock hdns, F40-B60; electric conductivity, high; thermal conductivity, high; machinability, fair. Conforms to ASTM specifications. Sheet, strip, plate, rods, bus bars, tubing and forgings. For bus bars, commutators, kettles, vats, distillery equipment, printing rolls, etc.

Alloy No. 101: Sheet, strip, and tube. Properties, depending on hardness: Ts, 32-55,000 psi; ys, 8-50,000 psi; elong in 2 in., 45-5%; Rock hdns, F40-B60. Better forming and bending qualities than Alloy No. 100. Preferred for copper smithing and welding because of resistance to embrittlement at high temperatures. In tube form, used for water and refrigeration service, heat exchange equipment and in oil burners. In sheet and plate form is recommended for welded construction.

Alloy No. 103: Has high electrical conductivity, is resistant to embrittling gases at high temperatures; is excellent for deep drawing, provides superior glass-to-metal seal. Physical properties depending on hardness: Ts, 32-50,000 psi; ys, 8-48,000 psi; elong in 2 in., 40-5%; Rock hdns, 40F-50B; produced to ASTM specifications. Excellent cold and hot working properties, excellent for soldering and polishing, has poor machinability. For special drawing and stamping, for sealing to glass, for electrical equipment at high temperatures in presence of reducing gases.

Alloy No. 105: Silver-bearing; is resistant to softening at temperatuures from 500-700 F; high conductivity. Physical properties depending on hardness: Ts, 33-52,000 psi; ys, 7-48,000 psi; elong in 2 in., 40-5%; Rock hdns, 40F-55B; produced to ASTM specifications. Excellent cold and hot working properties, fair machinability, excellent for soldering and polishing. For electrical commutators, and where retention of strength at moderately elevated temperatures is desired.

Alloy No. 106: Available in tube form only. Has low electrical conductivity. Physical properties depending on hardness: Ts, 37-60,000 psi; ys, 8-48,000 psi; elong in 2 in., 42-4%; Rock hdns, 28F-95F; produced to ASTM specifications. Excellent cold and hot working properties, poor machinability; weldability gas, metal arc and carbon arc processes, is excellent for soldering and polishing. For certain condenser and heat exchanger applications.

Alloy No. 205: Free-cutting copper; similar to Alloy No. 101 but has free-cutting properties; high electrical conductivity and high thermal conductivity. Physical properties depending on hardness, ts, 32-53,000 psi; ys, 7-49,000 psi; elong in 2 in., 40-7%; Rock hdns, 40F-45B; good cold and hot working properties, excellent machinability; is not recommended for welding, good soldering characteristics and excellent for polishing. For screw machine parts, welding torch tips, etc.

REVERE (Nickel alloys) — Revere Copper & Brass Inc., New York 17.

Alloy Nos. 533, 555, 535, 545, 548, 575; Nickel silvers. Copper-zinc alloys with nickel added primarily for its influence on colors. Color varies from a silver-blue-white to greenish, pink, or yellow-white. Nickel improves mechancial properties and greatly increases resistance to corrosion and tarnish. For wide variety of stamped and formed machine parts, architectural panels, springs, electrical fixtures, etc.

Alloy No. 510: Cupro-nickel. Properties, depending on hardness: Ts, 54-80,000 psi; ys, 16-75,000 psi; elong in 2 in., 45-5%; Rock hdns, B35-85; ductility, high; corrosion and erosion resistant; color, white-silver; conforms to ASTM specifications. Cold working properties, excellent; hot working properties, fair; machinability, fair; weldability, good. Excellent for soldering and good for polishing. For condenser tubes and plates, tanks, vats, vessels, and process equipment. Also for automotive parts, nuts, bolts, screws, meters, refrigerator pump valves, etc.

REVERE (Welding rods) — Revere Copper & Brass Inc., New York 17.

Silicon deoxidized copper welding rod for joining deoxidized copper plate and sheet. Melting point, 1980 F; ts of joint, 27,500-30,000 psi; hardness of joint, Rockwell F20-F30; corrosion resistance, excellent. Usable with both oxy-acetylene and inert gas shielded arc methods in production of sound copper welds.

No. 456 (low fuming): Manganese bronze all purpose rod. Melting range 1590 F-1630 F; joint properties: Ts, 56-67,500 psi; Rock hdns, B53-74; corrosion resistance, excellent. For production of tubular steel parts such as steel furniture, bicycles, etc, oxyacetylene welding of naval brass and manganese bronze sheets, plates and castings, as well as for overlaying to compensate for wear losses, building up resistant overlays, and the repair of cast iron in general maintenance welding.

Phosphor bronze: Grades A (5%) and D (10%) phosphor deoxidized tin bronze. Melting range (Grade A), 1750-1920 F; Grade D, 1550-1830 F; for joining phosphor bronzes, deoxidized and electrolytic copper sheet, steel and galvanized iron and brasses. Joint properties: Ts (Grade A), 42-44,000 psi; (Grade D), 49-50,000 psi. Employed with carbon arc method to weld oxygen-bearing coppers with minimum of adverse heat effects on base material. Builds up wear and corrosion resistant overlays by carbon and metal arc methods.

REX-A-LITE (Hardfacing rods) — The Sight Feed Generator Co., West Alexandria, O.

A series of three bare and coated rods of chromium, manganses, silicon, carbon and iron alloy for hardfacing of new and old machine parts subject to wear, abrasion, corrosion and red heat.

REXALLOY (High alloy castings) — Crucible Steel Co. of America, Atha Works, Harrison, N. J.

C 2.25, Cr 33.00, W 17, Co 44.00. Castings or finished round parts. Ts, 50-60,000 psi; modulus of elasticity, 35,300,000 psi; sp gr, 8.78; thermal conductivity at room temp, 4.8 btu/hr/sq ft/°F/ft; magnetic permeability at 200 oersteds, 1.004; corrosion resistance, excellent—resists corrosion to moist atmospheres, salt spray, milder acids and many strong acids. Exceptionally high red-hardness, resistant to abrasive wear, low coef of friction, and completely nonmagnetic. For valves and valve seats, hot extruston dies, plug gages, indicator anvils, wire guides, wear strips, etc.

REXARC (Overlay electrodes)—The Sight Feed Generator Co., West Alexandria, O.

Hardfacing and manganese electrodes. Oxy-acethylene and electric arc rods for build-up and hard facing of machine parts subject to wear, impact and abrasion.

REXTRUDE (Plastics)—Rex Corp., Cambridge, Mass.

Polyvinyl chloride custom and stock extruded flexible tubing, welding, tapes, lacing, belting, luggage binding, screen spline, and special shapes.

REX-TUNG (Tungsten carbide tube rods and peas)—The Sight Feed Generator Co., West Alexandria, O.

Fabricated tube rods for oxy-acetylene and electric arc application. A variety of screen sizes in fine quality crushed tungsten carbide. Also in pea size for application on bits, drills, etc.

REXWELD (Hard surfacing welding rod) — Crucible Steel Co. of America, Spaulding Works, Harrison, N. J.

A: C 1.00, Cr 28.00, W 4.5, Co 62.00. For hard surfacing parts of carbon-steel, alloy steel, stainless steel and cast iron. Weld deposit Rock hdns, C42-44; corrosion resistance, comparable to Type 18-8 stainless; wear resistance, excellent; oxidation resistance, excellent; shock resistance, excellent; good for hot-work applications. For clutch jaws, draw rings, exhaust valves, hot punches, hydraulic valves, knockout blades, millguides, shafts, shear blades, steam valves, trimming dies, etc.

B: C 1.50, Cr 28.00, W 7.50, Co 58.00 For hard surfacing parts of carbon, alloy and stainless steels and cast iron. Weld deposit Rock hdns, C48-50; corrosion resistance, comparable to Type 18-8 stainless; wear resistance, excellent; oxidation resistance, excellent; less tough but better wear resistant than Type A. For brake drums, concrete mixer blades, crusher rolls, sand - mixer plows, etc.

C: C 2.00, Cr 30.00, W 12.00, Co 51.00. For hard surfacing parts of carbon, alloy and stainless steel, and cast iron. Weld deposit Rock hdns, C53-55; corrosion resistance, comparable to Type 18-8 stainless; abrasion resistance, excellent; oxidation resistance, excellent; better in wear resistance than Type B but slightly lower in toughness. For bearings, bed plates, brick dies, bushings, cams, charging rams, lathe centers, tap-hole augers, etc.

REX Z METAL (Corrosion-resistant castings)—Chain Belt Co., Milwaukee 4.

Castings. Resists corrosion caused by weather and inorganic acids to a degree; max cont serv temp, 800 F; abrasion resistance, high; ts, 80,000 psi; ductility, medium; sp gr, 7.45; bearing properties, good; bhn, untreated, 200. For cast parts requiring high strength and good machinability.

REYNOLDS (Wrought aluminum alloys)—Reynolds Metals Co., Louisville 1, Ky.

EC: Drawn wire and redrawn rod.

2S: Flat and coiled sheet, plate, flattened wire, drawn wire, rolled or cold finished rod, bar, and rivets.

3S: Flat and coiled sheet, plate, flattened wire, drawn wire, rolled or cold-finished rod and bar, extruded rod and bar, solid extruded shapes, hollow extruded shapes, extruded tubing and pipe, drawn tubing and pipe.

4S: Flat and coiled sheet, plate, flattened wire, drawn wire, rolled or cold-finished rod and bar, round drawn tubing and pipe.

11S: Drawn wire, rolled or cold-finished rod and bar, forging stock.

14S: Extruded rod and bar, solid extruded shapes, forging stock, round extruded tubing and pipe.

A17ET: Rivets.

17S: Flattened wire, drawn wire, rolled or cold-finished rod and bar, rolled structural extruded shapes, screw machine stock.

18S: Forging stock.

24S: Flat and coiled sheet, plate, flattened wire, drawn wire, rolled or cold-finished rod

and bar, extruded rod and bar, solid extruded shapes, round extruded tubing and pipe, drawn extruded tubing and pipe.

Pure Clad 24S: Flat and coiled sheet, plate.

25S: Forging stock.

32S: Forging stock.

43S: Drawn wire.

C50S: Flat and coiled sheet, plate.

A51S: Forging stock.

52S: Flat and coiled sheet, plate, flattened wire, drawn wire, rolled or cold-finished rod and bar, round drawn tubing and pipe.

61S (formerly R361): Flat and coiled sheet, plate, flattened wire, drawn wire, extruded rod, bar and shapes, forging stock, extruded and drawn tubing and pipe, rivets and nails.

63S: Extruded rod, bar and shapes, tubing and pipe.

75S: Flat and coiled sheet, plate.

Clad 75S: Flat and coiled sheet, plate.

Hard Clad R301: Flat and coiled sheet, plate.

R317: Drawn wire, rolled or cold-finished rod and bar, forging stock, screw machine stock.

REZ-N-GLUE (Vinyl-plastic base cement) — Schwartz Chemical Co. Inc., New York 23.

Applied by brush, roller or glueing machine. Dries fast; crystal clear, entirely non-staining; no heat or pressure required. For cementing glass to plastics, metal or wood; setting bristle tufts in brushes, applying leather covers on optical instruments, and bonding laminates to wood veneers.

RIGIDIZED METAL (Sheet and strip metals)—Rigidized Metals Corp., Buffalo 3, N. Y.

Design - strengthened and textured stainless steel, aluminum, and other ferrous and nonferrous metals, sheet or strip, solid or perforated.

RIVER RS BRAND (Solder)—The River Smelting & Refining Co., Cleveland 1.

Solder in bar form produced to SAE and ASTM Specifications. Used for joining steel, brass, copper and aluminum.

RIVERSIDE (Nonferrous alloys) — Riverside Metal Co., Riverside, N. J.

Phosphor bronze, nickel silver and beryllium copper in sheet, strip, wire and rod form.

R. K. (Rigid plastic) — Sandee Manufacturing Co., Chicago 30.

Rods, tubes and special shapes. Good resistance to strong acids and alkalies; flex str, 12-14,000 psi; dielectric str, 425 (volts per mil inst); ts, 8-10,000 psi; imp str (Izod), 0.4-0.75 ft-lb per inch of notch; pastel shades; moisture absorp, 0.07-0.08; sp gr, 1.35-1.45; translucent and opaque; machinability, good; coef thermal exp'n, 6.9-18.5 x 10^{-5} inch/inch/degree C. For spacers, drain and coolant tubing, insulator parts, rollers, etc.

ROCKRITE (Seamless tubing)—Tube Reducing Corp., Wallington, N. J.

Available in alloy, carbon and stainless steels, and nonferrous metals. Supplied in cold-worked condition affording excellent machinability. Dimensional tolerances closer than standard.

ROSITE (Inorganic plastics) — Rostone Corp., Lafayette, Ind.

Compression custom molded calcium-aluminosilicate plastics. Resistant to alkalies; max cont serv temp, 900 F; dielectric strength (volts per mil inst), 80; ts, 1000 psi; comp str, 12-15,000 psi; in a variety of pastel shades; moisture absorp low; sp gr, 1.6; opaque; machinability, fair. Dimensionally stable, accurately molded, non-carbonizing. For electrical insulators, particularly where heat and arc resistance are needed.

ROSSLYN METAL (Clad metal) — American Cladmetals Co., Carnegie, Pa.

Sheets and tubes. A combination of Cr-Ni grades of stainless steel inseparably bonded to high conductivity copper interlayer. Sheets of standard AISI Types of stainless steel, 302, 304, 305, 308, 321, 347, etc., also Inconel and other nickel-base alloys. Used for jet plane parts, refrigeration units, high pressure canning equipment, heat conveying and heat dissipating equipment, etc.

ROSS-MEEHAN (Iron and steel castings)—Ross-Meehan Foundries, Chattanooga, Tenn.

Iron and steel castings to meet any existing ASTM specification for cast iron or cast steel. Coverage includes high, intermediate or low alloy and unalloyed. Materials used are all types of Ni-Resist, Ni-Hard, Monel, Nickel, RM-20 (under Durimet-20 license), Meehanite, and other wear-resisting, heat-resisting and corrosion-resisting steels. Castings to special or individual specification.

ROTOMETALS (Solder)—Rotometals, Inc., San Francisco 7.

Sn-Pb solder of all grades supplied in rod and bars and strip. For joining sheet metal, electric connections, etc.

ROYALITE (Thermoplastic composition)—United States Rubber Co., Chicago 39.

Copolymer of butadiene and acrylonitrile and styrene and acrylonitrile. Can be formed into intricate shapes; sawed, sheared, drilled, punched, sanded, sewed, cemented, polished. Supplied in standard sheet sizes, 50 x 62 in. and 50 x 84 in. in thicknesses ranging from $\frac{1}{32}$ to $\frac{1}{2}$ in.

100 Series: Ts, 4000 psi; flex str, 6,600 psi; mod elast, 240,000 psi; sp gr, 1.08; elong in 2 in., 40%; Rock hdns, 90R; imp str (notched Izod) at 70 F, 9.0 ft-lb; dielectric str, 390 (volts per mil inst).

No. 180: Ts, 9,400 psi; flex str, 14,000 psi; sp gr, 1.06; Rock hdns, 120R; imp str (notched Izod) at 70 F, 0.50 ft-lb; dielectric str, 385 (volts per mil inst).

No. 400: Ts, 2,500 psi; flex str, 4,000 psi; mod elast, 140,000 psi; elong in 2 in. 75%; Rock hdns, 50R; imp str (notched Izod) at 70 F, 12 ft-lb; dielectric str, 440 (volts per mil inst).

No. 700: Ts, 2,000 psi; sp gr, 1.12; elong in 2 in., 350%.

RS (Radio spaghetti)—Irvington Varnish & Insulator Co., Irvington, N. J.

Braided cotton sleeving coated with a smooth, continuous, lacquer film; conforms to ASTM and NEMA specifications for Grade A-B-2 flexible varnished tubing; highly resistant to aging, obtainable in five colors.

RUBEROID (Insulating tape) — Ruberoid Co., New York 18.

Electrical insulating tape. Abrasion and chemical resistance, high; max cont serv temp, 212 F; flexibility, high; dielectric, trans and flex str, high; ts, high; in black, opaque; shatterproof.

RUB-EROK (Rubber) — The Richardson Co., Melrose Park, Ill.

Hard rubber molded into parts, processing high dielectric strength, low moisture absorp, low loss factor. For electrical insulation; particularly desirable for electrical, heat and cold insulation; for industrial uses.

RUBYFLUID (Solder)—The Ruby Chemical Co., Columbus 8, O.

Sn-Pb solder in wire form with cored center flux; acid or rosin core; for all metals except aluminum.

RURALDUCTOR (Stranded steel conductor) — Bethlehem Steel Co., Bethlehem, Pa.

For rural power lines.

RY-AX (Heat-treated alloy steel)—Jos. T. Ryerson & Son, Inc., Chicago 80.

Finished rods and bars. Properties: (3¾ in. diameter and under): Ts, 100,000 psi; ys, 70,000 psi; elong in 2 in., 16%; bhn, 217-262. Unusually high fatigue resistance; stress relieved to minimize warpage during machining. For axles, armature shafts, power transmission units, tie rods, drift pins, gears, etc.

RYCASE (Free-cutting carburizing steel)—Joseph T. Ryerson & Son, Inc., Cleveland, O.

C 0.14-0.20, Mn 1.00-1.30, Su 0.08-0.13; P 0.045 max. Specially adapted for case-hardening. Hot-rolled rounds, ¼-8 in.; cold-finished rounds, $\frac{3}{16}$-6 in.; hot-rolled hexagons, ½-3 in.; cold-drawn hexagons, $\frac{7}{16}$-3⅛ in. Properties (heating to 1625 F, water quench and temper 400 F): Ts, 119,000 psi; ys, 99,000 psi; elong in 2 in., 19%; reduction area, 38%; bhn, 198. Readily machined and forged. For gears, threaded parts, etc.

RYCHROME (Heat-treated alloy steel)—Jos. T. Ryerson & Son, Inc., Chicago 80.

Finished rods and bars. Properties, heat treated (2½ in. diameter and under): Ts, 125,000 psi; ys, 105,000 psi; elong in 2 in., 16%; bhn, 269-321; machinability, good. For pinions, studs, roll mandrels, high temperature bolts and studs, etc.

RYCUT (Alloy steel)—Jos. T. Ryerson & Son, Inc., Chicago 80.

Finished rods and bars. Properties, unheat-treated: Ts, 102,000 psi; ys, 67,000 psi; elong in 2 in., 20%; bhn, 212. Properties, cold-drawn: Ts, 112,000 psi; ys, 94,000 psi; elong in 2 in., 16%; bhn, 223. Properties, heat-treated (2½ in. diam and under): Ts, 140,000 psi; ys, 120,000 psi; elong in 2 in., 15%; bhn, 297-341; machinability, 25-50% better than standard 0.50 carbon steels. For axle shafts, gears, wrenches, tools, pinion shafts, crankshafts, clutch parts, and gun barrels.

RYERSON (Steels)—Joseph T. Ryerson & Son Inc., Chicago 80.

Stocks of carbon, alloy and stainless steels in all standard forms. Complete hardenability data furnished with annealed and as-rolled alloys. (For property and application data on stainless steels see "Stainless Steels" listings at end of this section).

RYERTEX (Laminated plastics)—Joseph T. Ryerson & Son, Inc., Chicago 80.

Phenolic type laminated plastics having exceptional antifriction properties. Sheets, tubes and rods, fabricated bearings, bushings, wear plates, etc. May be lubricated with water, oil, grease, or hydrocarbons. Coef of friction with water lubrication 0.004; comp str, 37,500 psi; ts, 9400 psi; moisture absorp, low; max cont serv temp 275 F. For heavy and light-duty bearings, thrust plates, and applications requiring abrasion and chemical resistance.

RYEX (Steel mesh)—Joseph T. Ryerson & Son Inc., Chicago 80.

Steel mesh sheet for guards, enclosures, heat grids, etc.

RYTENSE AA (Alloy Steel)—Jos. T. Ryerson & Son, Inc., Chicago 80.

Finished rods and bars. Properties, unheat treated: Ts, 97,000 psi; ys, 60,000 psi; elong in 2 in., 25%; bhn, 201. Properties, cold drawn: Ts, 110,000 psi; ys, 93,000 psi elong in 2 in., 14%; bhn, 223. Properties heat treated: Ts, 126,000 psi; ys, 100,000 psi; elong in 2 in., 19%; bhn, 277. Machinability rating of 75% of AISI B1112. For motor and generator shafts, axles, spindles, gears, pump shafts, tie rods, studs and bolts, etc.

SABECO (Bearing bronzes)—Saginaw Bearing Co., Saginaw, Mich.

No. 5 bearing bronze: Cu 69-71, Sn 4.5-5.5, Pb 24-26 max, impurities 0.2. For light or medium-load and water-lubricated bearings.

No. 7: For connecting rods in refrigerating compressors and gasoline engines.

No. 9: Cu 69.71, Sn 8.5-9.5, Pb 20-22 max, impurities 0.2. For heavy loads such as average machine tool requirements.

No. 11: Cu 69-71, Sn 10.5-11.5, Pb 18-20 max, impurities 0.2. For worm wheels, clutch shifter shoes, forging machine slides, and extreme heavy bearing conditions.

No. 16: Cn 69-71, Sn 15-16.5, Pb 13.5-14.5 max, impurities 0.2. For friction rings, and heavy-duty boring spindle bearings.

SAFETEE (Glass and mirrors)—Safetee Glass Co., Philadelphia 44.

Laminated shatter-resistant glass mirrors to specification. Also a laminated, shatter-resistant glass in form of sheets and plates produced in many colors, transparent, translucent, or opaque.

SAFLEX (Thermoplastic plastics sheet)—Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Polyvinyl acetal thermoplastic sheet material used as interlayer in making "High-Test" safety glass.

SANDUSKY (Cast nonferrous alloys)—Sandusky Foundry & Machine Co., Sandusky, O.

Centrifugally cast bronze, brass and Monel sleeves, liners, tubes, bushings and roll covers from 3 to 54 inches in diameter in lengths up to 327 inches, depending upon diameters and metal composition. Rings are available from 3 to 72 inches diameter. Improved physical properties and machinability resulting from the Sandusky process.

Also bearing metals, copper-base metals and nickel base metals.

SANTOCEL (Insulation) — Monsanto Chemical Co., Merrimac Div., Everett Station, Boston 49, Mass.

Silica aerogel. Extremely efficient insulation with thermal conductivity K factor of 0.15 at mean temperature of 60 F. Each minute grain is honeycombed with millions of tiny pores—dead air spaces—which practically eliminate any heat transfer. Second only to perfect vacuum as insulating medium. Used to insulate refrigerators, freezers, refrigerated cabinets, coolers and display cases, frozen food lockers, shipping containers, trucks, railroad cars, piping and liquefied gas storage tanks.

SARAN (Polyvinylidene chloride plastic)—The Dow Chemical Co., Midland, Mich., and licensees.

Thermoplastic: Granules for molding; also special extruded and molded forms. Resistant to most inorganic chemicals and organic solvents; partially soluble in dioxane, cyclohexanone and certain chlorinated aromatic hydrocarbons; impervious to wa-

ter; nonflammable; dimensional stability, good; unusually high tensile strengths can be realized in forms which are completely oriented. For pipe, pipe liners, gaskets, fabrics; seat covers and window screening. Also furnished in film for packaging; bottle cap liners, and lamination to other films, foils, or paper.

SATCO (Lead-base, bearing alloy) — Magnus Metal Corp., New York.

Pb. 94-98, Sn-Ca and other auxiliary hardeners, balance. Melting pt about 125 degrees higher than that of tin-base and lead-base babbitt metals, with higher resistance to deformation and wiping at elevated temperature. Material is furnished in ingot form and also lined bearings. Properties untreated: Ts, 11-13,000 psi; comp str, 15-17,000; elongation, 8-12%; bhn, 22-24. Recommended as a lining for brass, bronze and steel back bearings. May be used as a substitute for lead and tin base babbitts, block tin and other bearing metals.

SCOVILL (Copper-base alloys) — Scovill Mfg. Co., Waterbury 91, Conn.

Gilding (Alloy No. 110): Cu 95, Zn 5, Strip, rod, wire and tubing. Ts, (soft .035mm) 35,000 psi, (hard) 55,000 psi; Rock hdns, (soft .035mm) F52, (hard) B60; coef thermal exp'n, 18.1 x 10^{-6}; electrical conductivity, 55% IACS.

Commercial Bronze (Alloy No. 120): Cu 90, Zn 10. Strip, rod, wire and tubing. Ts, (soft .035mm) 38,000 psi, (hard) 62,000 psi; Rock hdns, (soft .035mm) F60, (hard) B70; coef of thermal exp'n, 18.4 x 10^{-6}; electrical conductivity, 41% IACS.

Scovill Nu-Gild (No. 125 Alloy); Cu 87.5, Zn balance. Finished rods and bars, straight and coiled strip and wire. Properties, heat treated: Ts, 40,000 psi; elong in 2 in., 44%; Rock hdns, B62. Properties, cold worked: Ts, 65,000 psi; elong in 2 in., 5%; Rock hdns, B73; coef thermal exp'n, 18.5 x 10^{-6}; electrical conductivity, 39% IACS. For deep drawing parts.

Red Brass (Alloy No. 130): Cu 85, Zn 15. Strip, rod, wire and tubing. Ts, (soft .035mm) 41,000 psi, (hard) 70,000 psi; Rockwell hardness, (soft .035mm) F63, (hard) B76; coef thermal exp'n, 18.7 x 10^{-6}; electrical conductivity, 37% IACS.

Low Brass (Alloy No. 140): Cu 80, Zn 20. Strip, rod, wire and tubing. Ts, (soft .035mm) 43,000 psi, (hard) 72,000 psi; Rock hdns, (soft .035mm) F66, (hard) B76; coef thermal exp'n, 18.7 x 10^{-6}; electrical conductivity, 30% IACS.

Cartridge Brass (Alloy No. 160): Cu 70, Zn 30. Strip, rod, wire and tubing. Ts, (soft .035mm) 49,000 psi, (hard) 76,000 psi; Rock hdns, (soft .035mm) F68, (hard) F68, (hard) B82; coef thermal exp'n, 19.9 x 10^{-6}; electrical conductivity, 28% IACS.

Yellow Brass (Alloy No. 169): Cu 65, Zn 35. Strip, rod and wire. Ts, (soft .035mm) 49,000 psi, (hard) 76,000 psi; Rock hdns, (soft .035mm) F68, (hard) B82; coef thermal exp'n, 20.5 x 10^{-6}; electrical conductivity, 25% IACS.

Scovill Muntz metal (Alloy 180): Cu 61.5, Pb 0.30 max. Zn bal. Tubing, wire and rod. Properties, heat treated (0.035mm): Ts, 54,000 psi; elong in 2 in., 45%; Rock hdns, F80. Properties, cold worked (0.035mm): Ts, 70,000 psi; elong in 2 in., 10%; Rock hdns, B75. Coef thermal exp'n, 20.8 x 10^{-6}; electrical conductivity, 28% IACS; weldability, fair. For heat exchanger tubes, industrial plumbing, baffle plates. Excellent hot working properties.

Leaded Commercial Bronze (Alloy No. 215): Cu 89, Pb 2, Ni 1, Zn 8. Rod and wire. Ts, (soft .035mm) 37,000 psi, (hard) 62,000 psi; Rock hdns, (soft .035mm) F55, (hard) B70; coef thermal exp'n, 18.4 x 10^{-6}; electrical conductivity, 37% IACS.

Leaded Red Brass (Alloy No. 234): Cu 85, Pb 1⅞, Zn 13⅛. Ts, (soft .035mm) 40,000 psi, (hard) 65,000 psi; Rock hdns, (soft .035) F63, (hard) B67; coef thermal exp'n, 18.7 x 10^{-6}; electrical conductivity, 37% IACS.

Lanchasire Brass (Alloy No. 235): Cu 73, Pb 2¾, Zn 24¼. Strip. Ts, (soft .035mm) 44,000 psi, (hard) 75,000 psi; Rock hdns, (soft .035mm) F65 (hard) B82; coef thermal exp'n, 19.6 x 10^{-6}; electrical conductivity, 28% IACS.

Low Leaded Brass Tube (Alloy No. 241): Cu 67, Pb 0.6, Zn balance. Tubing. Properties, heat treated (0.035mm): Ts, 47,000 psi; elong in 2 in., 57%; Rock hdns, F64. Properties, cold worked (0.035mm): Ts, 75,000 psi; elong in 2 in., 8%; Rock hdns, B80. Coef thermal exp'n 20.2 x 10^{-6}; electrical conductivity, 26% IACS. For pipe pump lines, trap tubes. Cold working properties, excellent.

Scovill Low Leaded Brass (No. 251 alloy): Brass containing Cu 65, Pb 0.5, Zn balance. Straight and coiled strip, wire and rod. Properties, heat treated (0.035mm): Ts, 49,000 psi; elong in 2 in., 57%; Rock hdns, F68. Properties, cold worked (0.035mm): Ts, 74,000 psi; elong in 2 in., 8%; Rock hdns, B80. Coef thermal exp'n, 20.3 x 10^{-6}; electrical conductivity, 26% IACS. Cold working properties, excellent.

Matrix Brass (No. 253 alloy): Cu 64.5, Pb 1, Zn balance. Straight and coiled strip. Properties, heat treated (0.035mm): Ts, 49,000 psi; elong in 2 in., 54%; Rock hdns, F68. Properties, cold worked (0.035mm); Ts, 74,000 psi; elong in 2 in., 7%; Rock hdns, B80. Coef thermal exp'n, 20.3 x 10^{-6}; electrical conductivity, 25% IACS. For dials, engravings, instrument plates. Cold working properties, good.

Scovill High Leaded Brass (No. 263 alloy): Brass containing Cu 63, Pb 1.8, Zn balance. Straight and coiled strip, wire and rod. Properties, heat treated (0.035mm): Ts, 49,000 psi; elong in 2 in., 50%; Rock hdns, F68. Properties, cold worked (0.035mm): Ts, 74,000 psi; elong in 2 in., 7%; Rock hdns, B80. Coef thermal exp'n, 20.3 x 10^{-6}; electrical conductivity, 26% IACS. Clock and instrument frames. A free cutting alloy.

Scovill Extra High Leaded Brass (No. 265 alloy): Cu 63, Pb 2.5, Zn balance. Straight and coiled strip, tubing and rods. Properties, heat treated (0.035mm): Ts, 49,000 psi; elong in 2 in., 52%; Rock hdns, F68. Properties, cold worked (0.035mm): Ts, 74,000 psi; elong in 2 in., 7%; Rock hdns, B80. Coef thermal exp'n, 20.3 x 10^{-6}; electrical conductivity, 26% IACS. For clock gears, plate, backs, etc. A free cutting alloy.

Free Cutting Brass (Alloy No. 276): Cu 61½, Pb 3, Zn 35½. Rod and wire; Ts, (soft .035mm) 49,000 psi, (hard) 58,000 psi; Rock hdns, (soft .035mm) F70, (hard) B78; coef thermal exp'n, 20.5 x 10^{-6}; electrical conductivity, 25% IACS.

Forging Brass (Alloy No. 284: Cu 60, Pb 2, Zn 38. Rod and wire; Ts, (soft .035mm) 46,000 psi, (hard) 62,000 psi; Rock hdns, (soft .035mm) F75, (hard) B78; coef thermal exp'n, 20.6 x 10^{-6}; electrical conductivity, 25% IACS.

Oreide (Alloy No. 321): Tin brass containing Cu 89.5, Sn 0.50, Zn balance. Straight and coiled strip, tubing wire and rod. Properties, heat treated (0.035mm): Ts, 40,000 psi; elong in 2 in., 42%; Rock hdns, F65. Properties, cold worked (0.035mm): Ts, 63,000 psi; elong in 2 in., 5%; Rock hdns, B75. Coef thermal exp'n, 18.4 x 10^{-6}; electrical conductivity, 32%. For springs, clips, switch contacts, etc. Cold working properties, excellent.

Tin Brass (Alloy No. 322): Cu 90.5, Sn 1, Zn balance. Straight and coiled strip, wire and rod. Properties, heat treated (0.035mm): Ts, 41,000 psi; elong in 2 in., 42%; Rock hdns, F65. Properties, cold worked (0.035mm): Ts, 67,000 psi; elong in 2 in., 4%; Rock hdns, B77. Coef thermal exp'n, 18.4 x 10^{-6}; electrical conductivity, 32% IACS. For springs, etc.

Tin Brass (Alloy No. 323): Tin brass containing Cu 90.5, Sn 1.75, Zn balance. Straight and coiled strip. Properties, heat treated (0.035mm): Ts, 42,000 psi; elong in 2 in., 45%; Rock hdns, F64. Properties, cold worked (0.035mm): Ts, 69,000 psi; elong in 2 in., 4%; Rock hdns, B78. Coef thermal exp'n, 18.4 x 10^{-6}; electrical conductivity, 32% IACS. For springs, etc.

Tin Brass (No. 324 alloy): Cu 90.5, Sn 2.00, Zn balance. Straight and coiled strip. Properties, heat treated (0.035mm): Ts, 45,000 psi; elong in 2 in., 55%; Rock hdns, B25. Properties, cold worked (0.035mm): Ts, 70,000 psi; elong in 2 in., 3%; Rock hdns, B80. Coef thermal exp'n, 18.4 x 10^{-6}; electrical conductivity, 27% IACS. Excellent spring properties.

Optical Metal (No. 329 alloy): Cu 90.5, Sn 5, Zn balance. Finished rods and bars, straight and coiled strip, and wire. Properties, heat treated (0.035mm): Ts, 49,000 psi; elong in 2 in., 74%. Coef thermal exp'n, 18.4 x 10^{-6}; electrical conductivity, 20% IACS. Excellent spring properties.

Spring Bronze (Alloy No. 334): Tin brass containing Cu 86.5, Sn 2.1, Zn balance. Finished rods and bars, straight and coiled strip, and wire. Properties, heat treated (0.035mm): Ts, 50,000 psi; elong in 2 in., 55%; Rock hdns, B54. Properties, cold worked (0.035mm): Ts, 94,000 psi; elong in 2 in., 1%; Rock hdns, B84. Coef thermal exp'n, 18.7 x 10^{-6}; electrical conductivity, 26% IACS. For springs, diaphragms, etc.

Admiralty (Alloy No. 362): Tin brass containing Cu 81, Sn 1.5, Zn balance. Finished rods and bars, straight and coiled strip, tubing and wire. Properties, heat treated (0.035mm): Ts, 50,000 psi; elong in 2 in., 39%; Rock hdns, B44. Properties, cold worked (0.035mm): Ts, 90,000 psi; elong in 2 in., 6%; Rock hdns, B88. Coef thermal exp'n, 20.2 x 10^{-6}; electrical conductivity, 25% IACS. For condenser tube plates, etc. Cold working properties, excellent.

Phosphorized Admiralty (Alloy No. 363): Cu 71, Sn 1, Zn 28, P 0.03. Strip and tubing. Ts, (soft .035mm) 50,000 psi, (hard) 83,000 psi; Rock hdns, (soft .035mm) F70, (hard) B84; coef thermal exp'n, 20.2 x 10^{-6}; electrical conductivity, 25% IACS.

Naval Brass (Alloy No. 381): Cu 60, Sn 0.75, Pb 0.20, Zn balance. Finished rods and bars, tubing and wire. Properties, heat treated (0.035mm): Ts, 58,000 psi; elong in 2 in., 45%; Rock hdns, B55. Properties, cold worked (0.035mm): Ts, 86,000 psi; elong in 2 in., 15%; Rock hdns, B84. Coef thermal exp'n, 21.2 x 10^{-6}; electrical conductivity, 26% IACS.

Naval Brass Low Leaded (Alloy No. 382): Cu 60.5, Sn 0.75, Pb 0.75, Zn balance. Finished rods and bars and wire. Properties, heat treated (0.035mm): Ts, 63,000 psi; elong in 2 in., 35%; Rock hdns, B55. Properties, cold worked (0.035mm): Ts, 86,000 psi; elong in 2 in., 10%; Rock hdns, B82. Coef thermal exp'n, 21.2 x 10^{-6}; electrical conductivity, 26% IACS. Corrosion resistance, good.

Naval Brass High Leaded (Alloy No. 383): Cu 60, Sn 0.75, Pb 1.75, Zn balance. Finished rods and bars, and wire. Properties, heat treated (0.035mm): Ts, 58,000 psi; elong in 2 in., 29%; Rock hdns, B54. Properties, cold worked (0.035mm): Ts, 88,000 psi; elong in 2 in., 9%; Rock hdns, B89. Coef thermal exp'n, 21.2 x 10^{-6}; electrical conductivity, 26% IACS. For screw machine products.

Scovill Manganese Bronze (Alloy No. 385): Cu 58.5, Sn 1.0, Fe 1.0, Mn 0.30, Zn balance. Joint properties: Ts, 65,000 psi (soft), 84,000 psi (hard); Rock hdns, B65 (soft), B90 (hard). Hot working properties, excellent. Wear resistance, excellent.

Phosphor Bronze (Alloy No. 412): Cu 95, Sn 5, P. 0.35 max. Strip, rod and wire. Ts (soft .035mm) 50,000 psi, (hard) 86,000 psi; Rock hdns, (soft .035mm) F77, (hard) B87; coef thermal exp'n, 17.8 x 10^{-6}; electrical conductivity, 18% IACS.

Phosphor Bronze (Alloy No. 416): Cu 92, Sn 8, P 0.25 max. Strip, rod and wire. Ts (soft .035mm) 58,000 psi, (hard) 95,000 psi; Rock hdns, (soft .035mm) F80; (hard) B93; coef of exp'n, 18.2 x 10^{-6}; electrical conductivity, 13% IACS.

Alloy No. 510: Cu 65, Ni 5, Zn 30. Strip, rod and wire. Ts, (soft .035mm) 45,000 psi, (hard) 93,000 psi; Rock hdns, (soft .035mm) F64, (hard) B86; coef thermal exp'n, 16.8 x 10^{-6}; electrical conductivity, 12% IACS.

Nickel silver (No. 516 alloy): Cu 64.8, Ni 8, Zn balance. Straight and coiled strip. Properties, heat treated (0.035mm): Ts, 47,000 psi; elong in 2 in., 53%; Rock hdns, B73. Properties, cold worked (0.035mm): Ts, 93,000 psi; elong in 2 in., 3%; Rock hdns, B87. Coef thermal exp'n, 16.6 x 10^{-6}; electrical conductivity, 7% IACS. Cold working properties, excellent.

Alloy No. 520: Cu 65, Ni 10, Zn 25. Strip, rod and wire. Ts, (soft .035mm) 50,000 psi, (hard) 93,000; Rock hdns, (soft .035mm) F76, (hard) B89; coef of thermal exp'n, 16.4 x 10^{-6}; electrical conductivity, 8% IACS.

Nickel silver (Alloy No. 524): Nickel silver containing Cu 64.8, Ni 12, Zn balance. Flat and coiled strip. Properties, heat treated (0.035mm): Ts, 53,000 psi; elong in 2 in., 46%; Rock hdns, B22. Properties, cold worked: Ts, 88,000 psi; elong in 2 in., 3%; Rock hdns, B90. Coef thermal exp'n, 16.2 x 10^{-6}; electrical conductivity, 6% IACS. Cold working properties, excellent.

Alloy No. 525: Cu 65, Pb 1, Ni 12, Zn 22. Strip, rod and wire. Ts, (soft .035mm) 55,000 psi, (hard) 82,000 psi; Rock hdns, (soft .035mm) F80, (hard) B86; coef thermal exp'n, 16.2 x 10^{-6}; electrical conductivity, 6% IACS.

Alloy No. 530: Cu 65, Ni 15, Zn 20. Strip, rod and wire. Ts, (soft .035mm) 50,000 psi, (hard) 89,000 psi; Rock hdns, (soft .035mm) F70, (hard) B88; coef thermal exp'n, 16.2 x 10^{-6}; electrical conductivity, 6% IACS.

Alloy No. 535: Cu 65, Ni 18, Zn 17. Strip, rod and wire. Ts, (soft .035mm) 58,000 psi, (hard) 85,000 psi; Rock hdns, (soft .035mm) F85, (hard) B87; coef thermal exp'n, 16.2 x 10^{-6}; electrical conductivity, 6% IACS.

Alloy No. 537: Cu 55, Ni 18, Zn 27. Strip, rod and wire. Ts, (soft .035mm) 60,000 psi; (hard) 100,000 psi; Rock hdns, (soft .035mm) F90, (hard) B91; coef thermal exp'n, 16.7 x 10^{-6}; electrical conductivity, 5½% IACS.

Copper nickel 15% (No. 630 Alloy): Cu 85, Ni 15. Finished rods and bars, straight and coiled strip, tubing and wire. Corro-

sion resistance, excellent.

Copper Nickel (Alloy No. 640): Cu 80, Ni 20. Strip and tubing. Ts, (soft .035mm) 49,000 psi, (hard) 72,000 psi; Rock hdns, (soft .035mm) F73, (hard) B81; coef thermal exp'n, 16.2 x 10^{-6}; electrical conductivity, 6% IACS.

Copper Nickel (Alloy No. 660): Cu 70, Ni 30. Strip and tubing. Ts, (soft .035mm) 58,000 psi, (hard) 80,000 psi; Rock hdns, (soft .035mm) F80, (hard) B84; coef thermal exp'n, 16.2 x 10^{-6}; electrical conductivity, 5% IACS.

Aluminum Brass Type B (No. 744 Alloy): Cu 78, Al 2.1, As 0.03, Zn balance. Tubing. Properties, heat treated (0.035mm): Ts, 60,000 psi; elong in 2 in., 55%. For condenser, distiller tubes, etc. Corrosion resistance, excellent.

High Leaded Brass (Alloy No. 243): Cu 67.0, Pb 1.8, Zn balance. Tubing. Properties: Ts, 54,000 psi; elong in 2 in., 35%; machinability, good. For special machine and headed items.

Scovill Leaded Muntz Metal (Alloy No. 272): Cu 61.0, Pb 1.2, Zn balance. Properties (heat treated): Ts, 54,000 psi; elong in 2 in., 40%; Rock hdns, F80; machinability, good. For automatic screw machine products.

S. C. P. (Carbon)—Superior Carbon Products, Inc., 9115 George Avenue, Cleveland, Ohio.

Rods and plates. Max cont serv temp, below 1200 F; trans str 2000-4000 psi; moisture absorp low; hardness, 10-100 Scleroscope. For seal rings, bearings, molds, pump vanes, valve seats, electrodes, carbon brushes, etc.

SEACO (welding rod)—Stulz Sickles Co., Newark 5, N. J.

Bhn (as deposited) 500-600. A hard surfacing electrode primarily for protecting Manganal buildups and new manganese steel parts from abrasion wear until they have work hardened. Also effective over other types of steels.

SEALMET (Special alloy steel)—Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

Sealmet No. 1: Ni 28, bal Fe. Sealmet No. 4: Ni 42, Cr 6, bal Fe. Alloys having same coefficient of expansion as certain grades of glass. For application where metal wires or strip must be attached directly to glass.

SEALON (Liquid copolymer) — Maurice A. Knight Co., Akron 9, O.

Heavy viscosity liquid: For dipping, spraying, brushing then curing at 350 F in oven heat for 20 to 30 min per coat. Abrasion resistance, good; chemical resistance, very good; max cont serv temp, between 200 and 250 F; in green, black and white; moisture absorp, quite low; opaque. For agitators, fans, handles and for bonding to steel, copper, brass and aluminum.

SELECTRON (Plastic resins)—Pittsburgh Plate Glass Co., Pittsburgh.

Series of transparent, fast-curing thermosetting resins, can be used for many industrial applications. Selectron (5000 Series) resins are the copolymer type, furnished and applied as 100% solids cured at moderate temperatures without elimination of water and other volatile byproducts. May be cured with or without pressures, pigments, dyes, fillers or reinforcing materials. Monomers available at almost any viscosity with different adhesive qualities. Applied in impregnating, laminating, casting or molding operations, or as adhesives.

SELFLUBE (Bearing metal) — Keystone Carbon Co., Saint Marys, Pa.

Self-lubricating porous bronze, brass and iron bearing metal: Oil content, 15 to 35% by volume. Iron, brass, bronze structural parts. Bearings and parts held to close dimensions; used in automobiles, airplanes, business machines, household appliances, electric motors, clocks, farm implements, textile machinery, electronic devices, etc.

SEMINOLE HARD (Oil-hardening steel)—Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

C 0.52, Si 0.90, Cr 1.30, W 2.00, V 0.25. High creep strength bolts and studs for superheated steam; various machine parts subject to repeated shock and wear. Withstands moderately elevated temperatures—intermittent up to about 900 F. Should be hardened in oil.

SEYMOUR (Bearing Bronze)—Seymour Mfg. Co., Seymour, Conn.

Alloy No. 130: Cu 90, Sn 5, Pb 5. Finished rods and bars. Properties, cold worked: Ts, 55,000 psi; ys, 45,000 psi; elong in 2 in., 12%; sp gr, 8.9; nonmagnetic; machinability, good; weldability, poor. For bushings, screw machine parts, etc.

SEYMOUR (Nickel silvers)—Seymour Mfg. Co., Seymour, Conn.

Alloy No. 5: Cu 61, Zn 34, Ni 5. Wire form. Properties, spring temper: Ts, 135,000 psi; elong in 2 in., 2%; electrical conductivity (IACS), 12%.

Alloy No. 10A1: Cu 67, Zn 23, Ni 10. Sheet, wire and rod. Properties, spring temper: Ts, 109,000 psi; elong in 2 in., 1.5%; Rock hdns, B 88; sp gr, 9.64; electrical resistivity (IACS), 11.1; electrical conductivity (IACS), 9%.

Alloy No. 12X1: Cu 61, Zn 26, Ni 12, Pb 1. Rod form only. Properties, hard-drawn temper: Ts, 90,000 psi; elong in 2 in., 5%; Rock hdns, B87.

Alloy No. 15A: Cu 64, Zn 21, Ni 15. Properties, spring temper, ts, 93,000 psi; elong in 2 in., 5%; Rock hdns, B90; sp gr, 8.70; electrical resistivity (IACS), 15.9; electrical conductivity (IACS), 6.3%; furnished in sheet, wire and rod.

Alloy No. 15X1: Cu 60, Zn 24, Ni 15, Pb 1. Rod. Properties, hard-drawn temper: Ts, 85,000 psi; elong in 2 in., 10%; Rock hdns, B80; electrical resistivity (IACS), 16.7; electrical conductivity (IACS) 6%.

Alloy No. 18A1: Cu 65, Zn 17, Ni 18. Sheet, wire and rod. Properties, half-hard temper: Ts, 70,000 psi; elong in 2 in., 10%; sp gr, 8.75; Rock hdns, B80.

Alloy No. 18A4: Cu 55, Zn 27, Ni 18. Sheet and wire. Properties, spring temper: Ts, 110-145,000 psi; elong in 2 in., 2.3%; sp gr, 8.68; electrical resistivity 18.2; electrical conductivity (IACS), 5.5%.

Alloy No. 18X1: Cu 62, Zn 19, Ni 18, Pb 1. Rod. Properties, hard-drawn temper: Ts, 85,000 psi; elong in 2 in., 13%; Rock hdns, B80; electrical resistivity (IACS), 17.6; electrical conductivity (IACS) 5.7%.

Alloy No. 18A7: Cu 72, Zn 10, Ni 18. Sheet, rod and wire. Properties, spring temper: Ts, 80-115,000 psi; elong in 2 in., 2-7%; sp gr, 8.83; electrical resistivity (IACS), 16.2; electrical conductivity (IACS), 6.2%.

SEYMOUR (Phosphor bronzes)—Seymour Mfg. Co., Seymour, Conn.

Alloy No. 444: Cu 88, Zn 4, Pb 4. Properties, hard-drawn temper (small sizes): Ts, 60,000 psi; elong in 2 in., 20%; Rock hdns, B75; sp gr, 8.86; electrical resistivity (IACS), 8.2; electrical conductivity (IACS), 12.2%.

Alloy No. 494: Cu 94, Sn 5, Pb 1. Properties, hard drawn temper: Ts, 61,000 psi; Rock hdns, B85; electrical resistivity (IACS), 6; electrical conductivity (IACS), 16.8%.

Alloy No. 910: Cu 90, Sn 10. Properties, spring temper: Ts, 115,000 psi; elong in 2 in., 5%; Rock hdns, B100; sp gr, 8.76; electrical resistivity (IACS), 9.4; electrical conductivity (IACS), 10.6%.

Alloy No. 928: Cu 92, Sn 8. Properties, spring temper: Ts, 112,000 psi; elong in 2 in., 3%; Rock hdns, B98; sp gr, 8.80; electrical resistivity (IACS) 7.8; electrical conductivity (IACS), 12.8%.

Alloy No. 950: Cu 95, Sn 5. Properties, spring temper: Ts, 105,000 psi; elong in 2 in., 1.5%; Rock hdns, B95; sp gr, 8.86; electrical resistivity (IACS), 6.1; electrical conductivity (IACS), 16.5%.

S-G (Cast carbon steels)—The Symington-Gould Corp., Depew, New York.

Grade B: Properties, normalized: Ts, 70,000 psi; ys, 38,000 psi; elong in 2 in., 24%; reduction of area, 36%.

High-tensile: Properties, normalized and drawn: Ts, 96,000 psi; ys, 60,000 psi; elong in 2 in., 22%; reduction of area, 45%.

"SHAMVA" MULLITE (Ceramic refractory)—The Mullite Refractories Co., Shelton, Conn.

Grain cement, bricks and special shapes. Abrasion resistance, high; chemically neutral; softening temperature, 3250 F; dielectric str, better than mica; in natural color only; sp gr, varies with type, 2.77-2.30; machinability, poor; hardness, Moh's hardness scale, 6-7, coef thermal exp'n 0.00000366-in. per in. per in. per degree C. For feeder parts in glass molding machines.

SHARON (Steels)—Sharon Steel Corp., Sharon, Pa.

All standard carbon, alloy and stainless steels in standard forms. Straight and coiled strip and sheets for machining, hot and cold working, stamping, drawing, brazing, and arc, gas and resistance welding. For data on properties, characteristics, and applications of stainless sheets see "Stainless Steels" listing at end of this section.

SHELL DIE (Alloy steel)—A. Finkl & Sons Co., Chicago.

Cr 4.50-5.00, Si and Mo high. Normalized or quenched in oil or in air blast. For shell punches, mandrels and die inserts.

SHENANGO (High strength alloy castings)—Shenango-Penn Mold Co., Dover, O.

Centrifugal castings in all bronzes, Monel Metal and Meehanite metals. Complete range of red bronze alloys, as well as yellow metals including manganese bronzes and aluminum bronzes. Also special alloys such as aluminum and silicon bronzes, copper, etc., grades of plain and alloy iron, as well as Ni-Resist. Cast tubular bars or cylinders 2-26 in. OD and to 26 ft long; solid bars ½ to 8 in. diam in standard 6-ft lengths. For bearings, bushings, drums, liners, roll covers, sleeves, washers, rings, etc.

SHIELD-ARC (Welding electrode)—Lincoln Electric Co., Cleveland.

Type 85: High tensile welding rod. Recommended for fabrications of high tensile steels, Bhn, 190-250; ts, 77-82,000 psi. AWS E-7010.

Type 100: Bhn, 235-300; ts, 103-112,000 psi. AWS E-10010.

Type LH-70: For welding high-carbon, high-sulphur steels of poor welding quality. Ts, 75-80,000 psi. AWS E-6016.

SHOBER (Welding electrodes) — Shober Sales Inc., Stockton, Calif.

Mild steel welding electrodes in 1/16 to ⅜-in. diam rods. Strengths of welded joints: Ts, 65-75,000 psi; ys, 55-65,000 psi.

SHOCKPROOF (Malleable iron)—The Lake City Malleable Co., Cleveland 14.

Malleable iron within ASTM Specs No. 32510 and 35018. Ts, 52-55,000 psi; ys, 34-36,500; elong in 2 in., 12.5 to 20%; impact str (Charpy), 16.5 (.074 depth notch); endurance limit, 30,000-31,800 psi; bhn, 110-145; sp gr, 7.32; resists corrosion caused by atmospheres, moisture or water and smoke; max cont serv temp, 800 F. Resists shock and/or impact which may distort the casting but only under the most severe cases will it fail completely. For use in any machine, automotive transportation equipment, electrical fittings, and other applications.

SICROMO (Alloy steels)—Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, Ohio.

Type 1: C 0.15 max, Mn 0.30-0.60, P 0.03 max, S .03 max, Si 1-1.4, Cr 0.75-1.25, Mo 0.45-0.65. Rough bars, or billets, finished rods or bars, and tubing, for hot forging, welding, turning, boring, etc. Material is corrosion resistant to 1050 F; ts, 60,000 psi min; fair weldability; bhn, annealed, 163 max. For use in petroleum, chemical and steam generation industries.

Type 2: Similar to above with slightly higher chromium content (1.75-2.25).

Type 2½: Similar to Type 2 with slightly lower silicon content (0.50-1.0). Cr 2.25-2.75.

Type 3: Similar to Type 2½, with slightly higher silicon and chromium content (1.0-1.4 Si, 2.75-3.25 Cr).

Type 5: Similar to Type 3, with lower silicon content and higher chromium (0.50-1.0 Si, 4.0-6.0 Cr).

Type 5S: Similar to Type 5, differing only in higher silicon content (1.0-2.0 Si).

Type 7: Similar to Type 5S, having lower silicon and higher chromium content (0.5-1.0 Si, 6.0-8.0 Cr).

Type 7M: Similar to Type 7, but having an increased molybdenum content (0.9-1.10 Mo.)

Type 9: Similar to Type 7, having higher chromium content. All above materials are for oil refinery use (8.0-10.0 Cr).

Type 9M: Similar to Type 9, but having an increased molybdenum content (0.9-1.10 Mo).

SIL-AID (Silver brazing alloy)—United Wire & Supply Corp., Providence 7, R. I.

Ag 34, Cu 27, Zn 18, Cd 21. Good low cost competitive commercially important alloy. Ts, 60,000 psi; solidus, 1115F; liquidus, 1295F.

SILASTIC (Silicone Rubber) — Dow Corning Corp., Midland, Mich.

Silicone rubber serviceable at temperatures from below —70 to above 500 F. Dielectric properties, good; resistance to oxidation, outdoor weathering and a variety of chemicals in hot oils, excellent; compression set at high temperatures, excellent. Molding cycles and extruding rates compare favorably with those for organic rubbers, but oven curing is required to develop optimum properties.

General Purpose Silastic Stock: Durometer range of 45 to 85; ts, 360 to 700 psi; elong, 85 to 250%. Fabricated by molding extruding sheeting or calendering to form heat and oil resistance gasket steels mechanical parts laminates and electrical insulations.

Silastic Stocks 6000 Series: Properties similar to general purpose stocks except that brittle points are all below —100 F for extreme temperature application.

Silastic Stocks 7000 Series: Similar to general purpose stock properties except that compression set values at 302 F are only 10 to 35%. Used where maximum resistance to compression set at high temperatures is required.

Silastic 250: Durometer of 40-55; ts (avg), 650 psi; elong, 300%; brittle point, —130 F; serviceable at temperatures from —100 to +500 F.

SIL-BOND (Brazing alloy)—United Wire & Supply Corp., Providence 7, R. I.

Silver brazing alloy: Ag 47, Cu 20, Zn 17.5, Cb 15.5. Ts, 70,000 psi; solidus, 1120 F; liquidus, 1145F.

SILENTBLOC (Composite rubber-metal material)—The General Tire & Rubber Co., Mechanical Goods Div., Wabash, Ind.

Natural and synthetic rubber combined with metal. Used for mountings, bearings, couplings, motor and machine mounts to control vibration and cushion shock loads; lubrication-less oscillating or torque joints; and bushings to correct misalignment in bearings, hinges and shaft supports.

SIL-EX (Silver brazing alloy)—United Wire and Supply Corp., Providence 7, R. I.

Ag 50.0, Cu 15.5, Zn 16.5, Cd 18.0. Brazes most ferrous and nonferrous metals. Properties: Ts, 65,000 psi; solidus, 1160 F; liquidus, 1175 F.

SIL-FOS (Brazing rod) — Handy & Harman, New York 7.

Ag 15, Cu 80, P 5. Flows at 1300 F. In rods, wire, sheets and strip (coiled). Corrosion-resistant; ductility, high; sp gr, 8.45. Used to join nonferrous metals only, particularly copper brass and bronze.

SIL-LO (Silver brazing alloy)—United Wire and Supply Corp., Providence 7, R. I.

Ag 15.0, Cu 80.0, P 5.0. Suitable for brazing nonferrous metals only. Properties: Ts, 65,000 psi; solidus 1185 F; liquidus, 1445 F.

SIL-LON (Silver brazing alloy)—United Wire & Supply Corp., Providence 7, R. I.

Ag 40, Cu 30.5, Zn 29.5. Cadmium-free; excellent for general brazing. Ts, 75,000 psi.

SIL-LOY (Silver brazing alloy)—United Wire & Supply Corp., Providence 7, R. I.

Ag 65, Cu 20, Zn 15. Excellent color match for sterling. Ts, 63,000 psi; solidus 1280 F; liquidus, 1425 F.

SILMAN (Chisel steel) — Vanadium Alloys Steel Co., Anchor Drawn Steel Co., Colonial Steel Div., Latrobe, Pa.

C 0.55, Si 2.10, Mn 0.85, Cr 0.25, V 0.28. Rough bars or billets, finished rods or bars, wire, sheet, plate, forgings and drill rod, for permanent mold castings, precision castings, machining, hot and cold working, stamping, drawing and brazing. Properties, heat-treated state: Rock hdns, C62-63 max; magnetic; abrasion resistance, medium. For shanks, chisels, dogs, shears, etc.

SILMANAL (Magnet material) — Carboloy Co. Inc., Detroit, Mich.

Rod, strip or wire. High intrinsic coercive force, suitable for use in instruments where service in strong electrical fields is required. Ductile and malleable; can be punched, machined, rolled, or ground.

SILMO (Alloy steel)—The Timken Steel & Tube Div., The Timken Roller Bearing Co., Canton, Ohio.

C 0.15 max, Mn 0.30-0.60, P 0.4 max, S 0.045 max, Si 1.15-1.65, and Mo 0.45-0.65. Rough bars or billets, finished rods or bars, and tubing, for hot forging, welding, turning, boring, etc., into parts. Ts, 55,000 psi, min; max cont serv temp, 1000 F; weldability, fair; bhn, annealed, 163 max. For use in petroleum and chemical industries.

SIL-OID (Silver brazing alloys)—United Wire & Supply Corp., Providence 7, R. I.

Ag 31.5 Cu 34, Zn 15.5, Cd 19. Excellent low temperature, low cost alloy. Ts, 60,000 psi; solidus, 1165 F; liquidus, 1390 F.

SIL-TEX (Silver brazing alloy)—United Wire & Supply Corp., Providence 7, R. I.

Ag 60, Cu 25, Zn 15. Color matches sterling. Ts, 72,000 psi; solidus, 1260 F; liquidus, 1325 F.

SIL-TITE (Silver brazing alloy)—United Wire & Supply Corp., Providence 7, R. I.

Ag 45, Cu 30, Zn 25. Cadmium-free; exceptionally strong joints: Ts, 76,500 psi; solidus 1250 F; liquidus, 1370 F.

SIL-TRODE (Coated silicon - bronze welding rods)—Ampco Metal, Inc., Milwaukee 46.

Heavy, shielded-arc silicon-bronze electrode for use with metal-arc process. Primarily for welding silicon bronzes; can be used for welding copper, dissimilar metals and iron-base metals. Spray type arc action, low spatter loss, free flowing slag and weld metal producing crack-free, smooth dense deposits. Slag easily removed. Not recommended for bearing applications. Conforms to AWS-ASTM Spec. E Cu Si.

SILVERCOTE (Silver-plated wire)—Little Falls Alloys, Inc., Paterson 1, N. J.

Silver - plated beryllium-copper wire. For springs, wire forms, electronic parts, etc.

SILVER STAR (Spring steel)—Bethlehem Steel Co., Bethlehem, Pa.

High-carbon, high-manganese wire for coil springs.

SINTEEL (Steel and copper-steel powder metals)—American Electro Metal Corp., Yonkers, N. Y.

G: Copper-steel powder metal parts to design specification. Ts, 50-100,000 psi; ys, 40-80,000 psi; elong in 2 in., 20-5%; Rock hdns, B50-100; weldability, poor; abrasion resistance, medium. For high-strength precision powder metal parts.

R: Low-carbon steel powder metal parts to design specification. Can be surface hardened by gas carburizing or cyaniding. Ts, 61,000 psi; ys, 50,000 psi; elong in 2 in., 5%; Rock hdns, B60; abrasion resistance, medium. For cams, gears, and high strength powder metal parts requiring surface hardness up to Rock C55.

SIRVENE (Synthetic rubber)—Chicago Rawhide Mfg. Co., Chicago.

A series of scientifically compounded elastomers (synthetic rubbers), custom-developed to engineers' specifications and molded into mechanical pliable parts. Resistant to abrasion, oil, water, gases, air and temperature extremes. Used for sealing oils and greases, and for packings, gaskets and protective covers under unusual or difficult operating conditions.

SIRVIS (Mechanical leather)—Chicago Rawhide Mfg. Co., Chicago.

Leather, especially selected, tanned and treated for mechanical applications. Made in varying degrees of hardness or flexibility with high tensile strength and resilience. Used for protective boots, washers, gaskets, couplings and valve disks, bumpers, pads and friction members.

SIVYER (Cast steels) — Sivyer Steel Casting Co., Milwaukee 14, Wis.

Castings of carbon steels, carbon-molybdenum steels, manganese - molybdenum steels, chrome-nickel-molybdenum steels, chrome-molybdenum steels, chrome-molybdenum steels for refinery service, low temperature steels, and corrosion resistant steels.

SKO-RESIN (Thermosetting plastics) — Skoning Corp., East Providence, R. I.

Phenol formaldehyde base: Sheets, preforms, and powder for compression molding. Abrasion resistance, low to high; for structural moldings, housings and other structural parts.

SMAVROC (Alloy steel forgings)—The Medart Co., St. Louis.

For rolls for steel or nonferrous mill bar straighteners.

S-M-S Alloys (Resistance welding electrodes)—S-M-S Corp., Detroit 11.

Supplied completely machined, also in rods, bars, forgings and castings. For resistance welding of all metal parts.

SOFTWELD (Welding electrode)—Lincoln Electric Co., Cleveland.

For arc welding cast iron where a soft machinable weld is desired. Weld metal is high nickel alloy.

SOLDERALL (Solder) — Brach Mfg. Corp., Newark, N. J.

Solder in paste form comprising solder dust combined with noncorrosive dust. For soldering brass, copper, bronze and steel. Excellent for use in extremely fine or small work such as in radio wiring.

SOLEX (Heat resisting, glare reducing plate glass)—Pittsburgh Plate Glass Co., Pittsburgh 19, Pa.

Admits 70 to 75% of total light but transmits less than 43% of solar heat. Reduces glare from visible and ultra violet light. May be laminated with other glasses or used in window construction.

SORBO-MAT (Cast irons) — Sorbo-Mat Process Engineers, St. Louis.

A group of specially processed cast irons produced by licensees to meet wide variety of machine parts requirements.

SORBO-MAT (Cast irons)—Summer Iron Works, Everett, Wash.

A group of specially processed cast irons produced to meet wide variety of machine parts requirements.

SPAULDING ARMITE (Hard vulcanized fiber)—Spaulding Fibre Co., Inc., Tonawanda, N. Y.

Thin electrical insulation (fish paper) in sheets, rolls, coils and fabricated parts. Ductile; dielectric str, 200-550 (volts per mil inst); abrasion and corrosion-resistant; ts, 9000-15,000 psi.

SPAULDING FIBRE (Hard vulcanized fibre)—Spaulding Fibre Co., Inc., Tonawanda, N.Y.

Sheets, rods, tubes, and fabricated parts. Dielectric str, 150-400 (volts per mil inst); ts, 9000-15,000 psi; in colors; resistant to shock. For mechanical and electrical applications where toughness, light weight and machining and forming properties are essential.

SPAULDING T BOARD (Transformer Insulation)—Spaulding Fibre Co., Inc., Tonawanda, N. Y.

Sheet and strip. Max cont serv temp, 90 C; flexibility, high; dielectric str, 200-300 (volts per mil inst); ts, 3-8000 psi; moisture absorp, high; natural gray; sp gr, 1.05-1.15; opaque; machinability, good. Chemically inert in transformer oil; good forming qualities. For transformer collar and washer insulation.

SPAULDITE (Phenolic plastics) — Spaulding Fibre Co. Inc., Tonawanda, N. Y.

Phenolic base, thermosetting: Laminated sheets, rods, tubes, and fabricated parts. Dielectric str, 700 (volts per mil inst); moisture absorp, low; high polish, corrosion and heat-resistant (220 F); resistant to shock. For electrical insulation and where resistance to moisture and chemicals, appearance and permanence are essential.

SPAULDO (Insulation)—Spaulding Fibre Co., Inc., Tonawanda, N. Y.

Motor slot insulation in sheets, rolls and fabricated parts. Tear-resistant; dielectric str, 300 (volts per mil inst); max cont serv temp, 220 F; high polish; corrosion-resistant; ts, 5-16,000 psi; resistant to shock. For applications where flexibility and toughness in both grain directions are essential.

SPEER (Carbon and graphite) — Speer Carbon Co., St. Marys, Pa.

Carbon, electrographite, metal-graphite materials: Finished plates, bars, rods, for further machining. Not attacked except by oxidizing chemicals; starts to oxidize at 500 C; sp gr, 2-2.20; ts, 1000-4000 psi; crushing, 2800-4500 psi. Used for contacts, bearings, molds, dies, seal rings, etc.

S-POLYMER (Thermoplastic resin)—Enjay Co. Inc., New York 19.

Styrene-isobutylene thermoplastic resin. Granules and pellets for injection molding, compression molding, transfer molding, casting, extruding, and calendering. Abrasion resistance, high; very good resistance to acids, alkalies, water. Soluble in hydrocarbons and many organic solvents. Max cont serv temp, 130-140 F; dielectric str (volts per mil inst), 500-700; ts, up to 3000 psi; compr str, greater than 16,000 psi; light colored; can be compounded to any desired color; moisture absorp, low; sp gr, 0.98-0.99; opalescent; machinability, fair; hardness, Rockwell M10; very low moisture vapor and gas permeability; internally plasticized; good light stability; compatible with waxes and other resins; good metal adhesion. For food and tobacco packaging, wax modifier, electrical insulation, laminating agent for paper, fiber binder, processing aid and reinforcer for rubbers and resins.

SPONGEX (Sponge rubber)—The Sponge Rubber Products Co., Shelton, Conn.

Sheets, strips, rods and tubes extruded or molded. Abrasion resistance, low; chemical resistance, excellent against many commercial chemicals and oils; max cont temp, 175 F; flexibility, high; ts, 25-150 psi; in black, tan, red and other colors; opaque; shatterproof. For vibration elimination, cushioning, sealing and gasketing.

STAIN-CRAFT (Arc welding electrodes)—Allied Weld-Craft, Inc., Indianapolis 4, Ind.

Twenty-one different analyses of stainless rods ranging from AISI 308 through AISI 502. For joining stainless steels and straight chromium irons.

STAINLEND (Ac-dc arc welding electrodes)—Arcos Corp., Philadelphia 45, Pa.

Chrome-nickel coated rods for joining chrome-nickel alloys.

STAINWELD (Welding electrodes) — Lincoln Electric Co., Cleveland.

Coated electrodes for welding stainless steels or building up surfaces to resist corrosion.

Type A-5: For large number of so-called 18-8 stainless steels. Welds of high tensile strength and ductility and possess same resistant qualities as parent metal. Contains suitable amount of columbium to prevent intergranular corrosion of deposited metal. AWS E-347-15.

Type A-7: For stainless steels of 18 Cr, 8 Ni type; fast flowing, smooth operating. Especially adapted for surfacing other steels with minimum admixture of base metal. AWS E-347-16.

Type B: For arc welding stainless steel having chemical content of approx 25 Cr and 12 Ni. Physical properties equal to metal welded.

Type C: Modification of the well-known 18-8 analysis, commonly known as 18-8 SMO (approx 3½ Mo). Suitable for welding stainless steels of Types 316-317.

Type D: For stainless steels of 25 Cr, 20 Ni types; also for welding stainless steels to mild steel and for welding steels which are air-hardened and cannot be heat treated after welding. AWS E-310-15.

STANDARD ALLOY H-R (Nickel-chromium steel)—Standard Alloy Co., Inc., Cleveland, Ohio.

Low carbon Cr 18—Ni 8 to high analyses such as Ni 75—Cr 14. Centrifugal tube castings and sand castings to specification. Properties untreated: Ts, 70,000 psi; ys, 30,000 psi; elong in 2 in., 4-25%; bhn, 170 (avg); sp gr (avg), 8.3; are resistant to acids, salts and atmospheres; max cont serv temp, 1800-2000 F; abrasion resistance, high. For conveyor drums and belts, rails, drive shafts, grids, trays, roller rails, rolls, boxes and pots, rolling mill parts, gasoline and oil cracking unit parts, etc.

STANDARD (Steel tubing)—Standard Tube Co., Detroit 28.

Tubing in carbon, alloy and stainless steels. Available in a wide variety of shapes and sizes for uses such as roller conveyors, automotive parts, vacuum cleaner handles, washing machine rolls, etc.

STACKPOLE (Powder metals, carbon, metal-graphite, and magnetic materials)—Stackpole Carbon Co., St. Marys, Pa.

Silver-tungsten: For contracts for circuit breakers, relays, contactors, etc. Rock hdns, B 85-90; sp gr, 11.4-15; weldability, good.

Silver-molybdenum: Parts finished to size. Rock hdns, B80; sp gr, 10.3; weldability, good. For contacts for circuit breakers, relays, contractors, etc.

Iron powders: Molded to close tolerances. For gears, pole pieces for small motors, magnetic yokes, iron cores, also large parts and unusual shapes where much machining is ordinarily involved.

STEATITE (Ceramic) — General Ceramics & Steatite Corp., Keasbey, N. J.

Finished parts, rods, tubes and plates. Abrasion resistance, high; resists corrosion caused by alkalies and acids; max cont serv temp, 1800 F; dielectric str, 300 (volts per mil inst); ts, 9500 psi; comp str, 81,000 psi; moisture absorp, none; in white; impact resistance, 2.27 psi; sp gr, 2.7; opaque. For light bearings, radio frequency insulating parts, etc.

STEEL-TECTIC ('Non-stop' electrode)—Eutectic Welding Alloys Corp., New York 13.

Mild steel electrode for use at exceptionally low amperages to reduce warping, distortion and stress. Will deposit multi-pass welds without intermediate slag chipping, and can be used in all positions. Particularly efficient for poor-fit work or mass production set-ups.

STERLING (Insulating varnishes)—The Sterling Varnish Co., Haysville, Pa.

A complete line of insulating varnishes for all types of electrical windings.

STERLING (Stainless steels) — Firth-Sterling Steel and Carbide Corp., McKeesport, Pa.

Standard stainless steels furnished to AISI specifications. For property and application data, see "Stainless Steels" listing at end of this section.

ST. MARYS (Carbon, graphite, and metal-graphite products)—St. Marys Carbon Co., St. Marys, Pa.

Pressed and sintered parts made of graphite, copper alloys and other materials blended to produce the type of material required for specific applications. For pressure contact, bearings, seals, resistors, bushings, bearings, brushes, plates, small production parts and filter materials.

STONEWALL (Babbitt) — United American Metals Corp., Brooklyn 22, N. Y.

Bars and pigs. Properties, cold-worked: Ts, 10,800 psi; comp str, 16,380 psi; ys, 8720 psi; elong in 2 in., 0.07%; bhn, 24.3. For heavy-duty high-speed service.

STONEWALL (Asbestos cement board)—Rubberoid Co., New York 18.

Sheets. Abrasion resistance, high; max cont serv temp 450-500 F; nonflammable; flexibility, low; ts, 1900 psi; comp str, 10,000 psi; modulus of rupture, 3500 psi; moisture absorp, medium; in natural gray; opaque; shatterproof; sp gr, 1.92. For electrical control bases, switch cells, etc.

STOODITE (Hard facing rod)—Stoody Company, Whittier, Calif.

Cast, of Cr, Mn, Zr, Si, C and Fe. Rock hdns, C 54-58. Used on parts subjected to sliding friction such as plowshares and steel mill guides. Polishes under abrasion, resists galling and pitting. For oxyacetylene and d-c electric application.

STOODY (Hard facing rod)—Stoody Company, Whittier, Calif.

Stoody 1: Cast hard-facing rod of Co, Cr and W. Rock hdns, C54. Resistance to abrasion and corrosion, even at red heat, high. For hard-facing under-reamer lugs, carbon scrapers, wire guides, wood saw teeth, etc. For oxyacetylene and a-c and d-c electric application.

Stoody 6: Cast hard-facing rod of Co, Cr and W. Rock hdns, C41-43. Abrasion, corrosion and impact resistance, high. These qualities retained at red heat; machinable with sintered carbide tools. For high-pressure, high-temperature valves, hot trimming dies, exhaust valves and seats, etc. For oxyacetylene and a-c and d-c- electric application.

STOODY (Hard-facing wires in coils)—Stoody Company, Whittier, Calif.

For automatic electric application. Tubular wire produced in several variations in analysis to meet specific conditions of abrasion impact, corrosion and heat, as follows:

Stoody 101: Submerged arc; Rock hdns, C-34-36; resistance to abrasion and corrosion, good. Recommended for clutch plates, brake drums, large journal bearings surfaces, etc.

Stoody 102: Submerged arc; Rock hdns, C50-52. Designed for building up steel mill coiler and straightener rolls. Multiple passes applied easily.

Stoody 103: Submerged arc; Rock hdns, C-52-56; analysis similar to manual Stoodite; recommended for severe abrasion.

Stoody 105: Submerged arc; Rock hdns, C46-48. Designed for building up tractor idlers and rollers. Multiple-pass deposits may be made.

Stoody 106: Submerged arc; Rock hdns, C38-42; abrasion resistance, moderate; impact resistance, high. Under base for higher alloy deposits. Roll neck, pump sleeves, shafting, etc.

Stoody 107: Submerged arc; Rock hdns, C36-41; abrasion resistance, good; impact resistance, high. Under base for higher alloy deposits. Leveler rollers, mine car wheels, etc.

Stoody 121: Open and submerged arc; Rock hdns, C50-54; wear resistance, very high. Recommended for crusher parts, handling equipment, scraper blades, etc.

Stoody 122: Submerged arc; Rock hdns, C-51-53; low cost, general-purpose wire. Recommended for tool joints, loading equipment, crane wheels, etc.

Stoody 130: Open arc; hardness, Moh's scale 9-10. Automatic electric Tube Borium. Recommended for hard-facing grader blades, scraper blades, and earth-working and cutting equipment.

Stoody Manganese: Open or submerged arc; full Hadfield manganese steel properties. For building up crushers and other manganese parts before hardfacing.

Stoody High Carbon: Submerged arc; premium high carbon wire; Rock hdns, C28-30 (air cooled). For building up steel parts before hard facing.

STOODY SELF-HARDENING (Hard facing rod)—Stoody Company, Whittier, Calif.

Fabricated steel hard-facing rod containing Cr, Mn, Si, Mo, C and Fe. Rock hdns, C52-56. Can be forged at red heat; forms excellent bond with manganese steel; has high resistance to severe abrasion and impact. Widely used for heavy construction equipment; crusher jaws, bucket lips, grader blades, etc. For oxyacetylene and a-c and d-c electric application.

Stoody Self-Hardening 21: Fabricated steel hard-facing rod containing Cr, Mn, Si, Zr, and Fe. Rock hdns, C 54-56. Deposits contain about 18% alloys. For high resistance to severe abrasion and impact encountered in heavy construction equipment, crushing equipment, manganese steel parts and the like. Bare rods give high deposition rate, a-c or d-c-.

Stoody 1027: Alloy-coated hard-facing rod containing Cr, Mn, Fe and C. Rock hdns, C48. Forgeable at red heat. Bonds readily with manganese steels. Possesses good wear resistance and high impact strength. Excellent weldability permits all-position welding. For dredge pump castings, impellers, tractor idlers and such parts as cannot be positioned.

STOODY TUBE BORIUM (Hard facing rod)—Stoody Company, Whittier, Calif.

Fabricated steel rod containing regularly shaped particles of cast tungsten carbide in various screen sizes. Hardness is 9-10 on Moh's scale. Deposits are heterogeneous, the tungsten carbide particles being floated in the steel matrix. Used on earth working equipment, drill bits and equipment subjected to severest types of abrasion. For oxyacetylene and a-c, d-c electric applications.

STRAIN-TEMPERED (Cold finished steels) — Bliss & Laughlin Inc., Buffalo, N. Y.; Harvey, Ill.; Mansfield, Mass.

Medium and high-carbon cold-finished steels having high physical properties and high ductility.

STRENES C (Gray iron)—The Advance Foundry Co., Dayton 3, O.

Alloyed high-strength gray iron in sand castings. Properties, untreated: Ts averages 50,000 psi; bhn, 220; impact str (charpy), 70 ft-lb. weldability, fair; abrasion resistance, medium; max cont serv temp, 1500 F. Used for cast stamping, forming and drawing dies, jigs, fixtures, die rings, cylinders, and all wearing surfaces as in machine tools.

STRESSPROOF (Manganese steel) — La Salle Steel Co., Hammond, Ind.

A severely cold-worked furnace-treated carbon steel bar: C 0.40-0.48, Mn 1.35-1.65, P 0.040 max, S 0.24-0.33, Si 0.15-0.30. Finished bars for machining. Ys, 100,000 psi min in sizes ⅝-in. to 2 in. and 90,000 psi min. in sizes over 2 in. through 3¼ in. Machines approximately 125 sfpm. Requires no heat treating but has replaced carbon and alloy carburizing steels. Available both cold drawn and ground and polished. Used for worm gears, lead screws, spindles, shafts, etc.

STRONG #18 (Steel castings) — Strong Steel Foundry Co., Buffalo 7.

C 0.3-0.35, Mn 0.9-1.1, Si 0.25-0.35, P and S under 0.05. Properties, normalized and drawn: Ts, 80,000 psi; ys, 40,000 psi; elong in 2 in. 20%; bhn, 160-180; machinability, good; weldability, good; abrasion resistance, medium. Generally used for large gears.

STUPAKOFF (Ceramic)—Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.

No. 621: Seattle ceramic in finished form made by molding, casting, machining, stamping, extruding. Abrasion resistance, high; resists corrosion caused by acids and alkalies, except hydrofluoric acid; dielectric str, 200 (volts per mil inst); ts, 9000 psi; comp str, 75,000; moisture absorp, low; available with colored glaze; sp gr, 2.6; opaque. For electrical insulating parts.

No. 1100: Ceramic in rods and tubes. Abrasion resistance, high; chemical resistance, good; max cont serv temp 1800 F; nonflammable; flexibility, low, 7000 psi; comp str, 70,000 psi; flex str, 18,000 psi; available in white to cream colors; opaque; shatterproof; sp gr, 2.56. For use in radio and high-frequency applications.

STUPALITH (Ceramic)—Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.

Formed by pressing, extruding, and casting and, where desired, by subsequent machining or grinding. Excellent thermal expansion characteristics. Properties: Linear coef of thermal exp'n, $\pm 1.5 \times 10^{-6}$; thermal distortion, none at 2000 F; water absorb, 0-18% as desired; sp gr 2.1-2.4; moisture exp'n, 0.0; dielectric str, 140 volts per mil; max cont serv temp, 2192 F.

STYRON (Polystyrene plastic) — The Dow Chemical Co., Midland, Mich.

Thermoplastic: Granular form for injection and extrusion molding. High optical clarity;

moisture absorp, low; dimensional stability, good; electrical properties, exceptionally good; sp gr, 1.05 to 1.07; heat distortion, 160 to 190 F; crystal, translucent, transparent, and opaque colors. Special formulations available with improved light stability; improved heat resistance; improved impact and elongation. For electrical insulators, fluorescent light fixtures, wall tile, combs, radio cabinets, toys, refrigerator parts, television parts, camera cases, and household items.

SUMET (High leaded bronzes)—Sumet Corp., Buffalo.

SM-8: Pb 24-27. For moderate speed and general service; suitable for machine tool bearings.

SM-10: Pb 22-25. For general applications such as aeronautical engines, clutch cones and disks, compressors, connecting rods, crank pins, etc.

SM-12: Pb 20-23. For cone and gyratory crushers, crane and ore machinery, mining machinery, etc.

SM-14: Pb 12-15. For thrust bearings, gears, etc.

SM-16: Pb 19-21. For heavy-duty service such as crane motor compressor, dredging machinery, etc.

SM-18: Pb 16.5-18.5. For crosshead pins, cranes, railroad, steam shovels, etc.

SUMMERILL (Seamless tubing) — Summerill Tubing Co., Pittsburgh, Pa.

Cold drawn seamless steel tubing; mechanical, condenser, heat exchanger, pressure, diesel fuel injection, aircraft, sporting goods. All commonly used grades in carbon and alloy steel. Special O.D. and I.D. finishes.

SUPERGRAPH (Carbon, graphite, and metal-graphite)—Superior Carbon Products, Inc., Cleveland, O.

Round and rectangular shapes and finished parts. For bearings, valve seats, brushes, seal rings, etc.

SUPERIOR (Chrome-plated steel strip) — Superior Metal Co., Chicago 38.

Corrosion-resistant strip chrome-nickel-plated and finished bright on one side, satin finished on other side. Coiled or straight strip for stamping. Properties, cold-worked: Max cont serv temp, 750 F; resists corrosion caused by moisture; magnetic; max cont serv temp 250 F. For any mildly drawn part requiring chrome plating.

SUPERIOR (Magnesium base alloy) — Superior Bearing Bronze Co. Inc., Magnesium Div., Brooklyn 22.

Magnesium castings for specific requirements.

SUPERIOR (Seamless brass and copper tubing) —Penn Brass & Copper Co., Erie, Pa.

From 5/32-in. OD x 0.010-in. wall, to and including 1-in. OD x 0.072-in. wall; both in copper of pure electrolytic mixture and in brass of 3 alloys, namely; 70/30, 2-1 leaded and 85/15.

Furnished to the following ASTM specifications:

Copper: B 68-47. Bright annealed
B 75-47T, General-purpose
B 188-47T, Electric conductors
Brass: B 135-47T, Alloy 85/15, 20/30, 66/33 leaded.

SUPERIOR (Metal tubing)—Superior Tube Co., Norristown, Pa.

Carbon steels: AISI MT C-1008, 1010, 1015, 1020, 1025, 1035, and 1095.

Alloy steels: AISI MT 4130, 4155 and 52100.

Stainless steels: Seamless and Weldrawn AISI types 303, 304, 316, 317, 321, 347, 403, 420, 430, 446 and 502 (T-1).

Nickel alloys: Seamless and Weldrawn "A-Nickel," Monel, "K-Monel," Inconel and 30% cupro-nickel.

Specialties: Invar (36% nickel-iron), 42% and 52% nickel-iron, 27% chrome stainless, 18-12 stainless, 18% nickel silver, seamless and Weldrawn beryllium copper. Electronic cathode and anode parts; diesel high and low-pressure fuel-injection tubing. super-pressure and hydraulic tubing.

Above available in all shapes, in sizes ranging from 0.010 to ⅝-in. OD in the round. Sizes to 1⅛-in. OD x 0.042-in. wall maximum in special analyses. Specializing in tubing drawn to all applicable AMS, ASTM, Army and Navy specifications.

SUPERIOR No. 3 (High alloy steel)—Braeburn Alloy Steel Corp., Braeburn, Pa.

C 1.50, Cr 12.00 V 0.85, Mo 0.80. Rough bars or billets and finished rods or bars. Properties, heat-treated: Comp str, 550,000 psi; Rock hdns, C56-62. For forming rolls, lathe and grinder centers, etc.

SUPERIOR (Stainless strip steel) — Superior Steel Corp., Carnegie, Pa.

Hot and cold-rolled strip stainless steels in all standard grades and analyses. For data on type, properties, characteristics, and applications see "Stainless Steels" listing at end of this section.

Also hot and cold-rolled alloy strip steels and high-carbon untempered spring steels.

SUPERMAL (Pearlitic malleable irons)—Jeffrey Mfg. Co., The, Columbus 16, O.

Properties, heat-treated: Ts, 75,000 psi min; ys, 55,000 psi min; elong in 2 in., 8% min; bhn, 187-217; abrasion resistance, good. For chain links, sprockets, etc.

SUPER Y (Alloy malleable castings)—Chicago Malleable Castings Co., 1225 West 120th St., Chicago 43, Ill.

Properties, normal annealed: Ts, 60,000 psi; ys, 40,000 psi; elong in 2 in., 16%; bhn, 143.

SUPREME (Welding rods and electrodes)—Bolivar Welding Wire Co., Bolivar, Pa.

Steel welding rods used for joining steel, cast irons and ferrous alloys.

SURCO AMERICAN (Thermosetting plastics) — Surprenant Mfg. Co., Boston, Mass.

Sheets, rods or tubes. Abrasion resistance as required; resists corrosion caused by acids and other corrosion elements; heat resistant to the degree required; flexibility as required; dielectric str, 1500 (volts per mil inst), avg; ts, 200-4500 psi; moisture absorp, low; available in 26 colors; shatterproof; sp gr, .90-1.45; opaque; machinability, good. For control cables, etc. in machine tools.

SURFACEWELD "A" (Hardsurfacing alloy)—Lincoln Electric Co., Cleveland.

Fine-grained alloy powder to be applied with the carbon arc to produce a smooth, dense, abrasion-resisting surface. Deposit (depending upon amount of admixture with base metal), has approx Rock hdns, C54. Deposit develops full hardness in as-deposited condition; maintains hardness at high temperatures and resists scaling at high temperatures. Corrosion resistance comparable to that of stainless steel; abrasion resistance, excellent; should not be used where impact is excessive. Deposit as thin as 0.025 in can be applied to light gauge metal.

SUVENEER (Clad steel)—Superior Steel Corp., Carnegie, Pa.

Steel clad on one or both sides with stainless, nickel, Monel, copper, and some copper-base alloys, etc. Strips for stamping, welding, deep drawing, rolling, spinning, soldering, etc.

SWEET HOME BRAND (Resin-bound plywood) —Oregon Plywood Corp., Sweet Home, Oregon.

Phenolic resin-bonded, thermosetting fir plywood. Moisture and water resistant. For aircraft cabinets, instrument panels, bases, bodies, boxes, etc.

SYNTHANE (Phenolic laminated plastics)—Synthane Corp., Oaks, Pa.

Thermosetting: Corrosion resisting. Sheets, rods and tubes, fabricated parts, and in parts made by molding the impregnated base materials. Available in following grades:

X: Kraft paper base, hard resin, laminated material. For mechanical applications where electrical requirements are of secondary importance; ts, 12,500 psi.

XP: Kraft paper base, plasticized resin, laminated material. Primarily intended for punching; more flexible and not quite as strong as Grade X; moisture resistance and electrical properties intermediate between Grades X and XX.

XX: Cotton rag paper base laminated material. Hard, greater percentage of resin than Grade X. Suitable for usual electrical applications; machinability, good.

XXP: Cotton rag paper base laminated material. Similar to Grade XX in electrical and moisture-resisting properties, but more suitable for hot punching. Intermediate between Grades XP and XX in punching and cold flow characteristics.

XXX: Cotton rag paper base laminated material. For radio frequency work, high humidity applications, minimum cold flow characteristics.

XXXP: Cotton rag paper base laminated material. Similar to Grade XXX but with lower dielectric losses and more suitable for hot punching; greater cold flow than Grade XXX and intermediate between Grade XXP and XXX in punching characteristics.

C: Heavy-weave fabric, base laminated material made throughout from cotton fabric weighing over 4 oz per sq yd, and having a count of not more than 72 threads per in. in the filler direction, nor more than 140 threads per in. total in both warp and filler direction. Strong, tough material suitable for gears and other applications requiring high impact strength. Available in subgrades, depending upon sizes of gears and types of mechanical service. Should not be used for electrical applications.

CE: Heavy-weave fabric base laminated material, same as Grade C. For electrical applications requiring greater toughness than Grade XX, or mechanical applications requiring greater resistance to moisture than Grade C.

L: Fine weave fabric base laminated material, of cotton. For small gears and other fine machining applications, particularly in thickness under ½-in. Not quite as tough as Grade C; should not be used for electrical applications except for low voltage.

LE: Fine weave fabric base laminated material, same as Grade L. For electrical applications requiring greater toughness than Grade XX; better machining properties and finer appearance than Grade CE. Also available in thinner sizes. Exceptionally good in moisture resistance.

SYNTHOLVAR (Thermoplastic plastics) — Varflex Corp., Rome, N. Y.

Vinyl chloride acetate: Form of tubes. Abrasion resistance, high; dielectric str (volts per mil inst.), 700-1000; ts, 2500-3000 psi; moisture absorp, low; transparent and opaque; hardness, Shore Durometer, 80-85. Used as insulation by manufacturers of many types of electrical equipment.

SYROCOWOOD (Molded wood)—Syracuse Ornamental Co. Inc., Syracuse, N. Y.

Thermosetting and thermoplastic: Molded parts. Abrasion resistance, low; flexibility, low; opaque. For nameplates or decorative parts, also for radio type control knobs.

TI (Plastic)—Sandee Manufacturing Co., Chicago 30.

Cellulose acetate thermoplastic rods, tubes and special shapes. Not affected by weak inorganic acids, alkalies; flex str, 2600-3500 psi; dielectric str, 290-600 (volts per mil inst); ts 2300-8100 psi; imp str (Izod), 0.3-5.2 ft-lb per inch of notch; all colors; moisture absorb, high; transparent, translucent and opaque; machinability, good; coef thermal exp'n, 8-16 x 10^{-5} inch/inch/degree C. For spacers, washers, knobs, etc.

T2 (Plastic)—Sandee Manufacturing Co., Chicago 30.

Cellulose acetate butyrate plastic rods, tubes and special shapes. Resists weak inorganic acids and alkalies; flex str, 1500-9300 psi; dielectric str, 250-400 (volts per mil inst); ts, 1500-6800 psi; imp str (Izod), 0.6-9.6 ft-lb per inch of notch; all colors; moisture absorp, medium; sp gr, 1.13-1.23; transparent, translucent and opaque; machinability, good; coef thermal exp'n, 11-17 x 10^{-5} inch/inch/degree C. For spacers, washers, drain tubing, etc.

TALIDE (Tungsten carbide) — Metal Carbides Corp., Youngstown, O.

Rough bars or billets, finished rods or bars, tubing, permanent mold castings, and powder metals. Self-hardening during processing. Properties, heat-treated: Ts 300,000 psi; comp str, 750,000 psi; impact str (Charpy), 1.10; Rock hdns, C 90-92; sp gr, 14.60; nonmagnetic; weldability, good; resists most acids and chemicals; max cont serv temp, 2000 F; abrasion resistance, high. Maintains cutting edge while red hot. Used for cutting tools, drawing dies, drill jig bushings, lathe and grinder centers, centerless grinder blades, sand blast nozzles, guides, wear-resistant plates, etc.

TAM (Titanium alloys)—Titanium Alloy Mfg. Div., National Lead Co., N. Y. 6.

Alloys including original high and medium-carbon ferro carbon-titanium, foundry ferro titanium, and several varieties of low-carbon ferro-titanium for rolled cast and forged steels, stainless and alloy steels, and gray cast iron.

TANTUNG (Nonferrous casting alloy) — Vascoloy-Ramet Corp., Waukegan, Ill.

Co 45-50, Cr 37-32, W 14-19, C 2-4, Ta 2-7, Mn 1-3, and Fe 2-5. Fabricated by sand, permanent-mold and precision castings. No heat treatment required. Ts 65,000 psi; Rock hdns, C 53-63; trans rupture str, 320,000 psi; nonmagnetic; machinability, poor; weldability, poor; max cont serv temp, to 1600 F; resists corrosion caused by fruit and vegetable acids, nitric acid, phosphoric acid, sodium carbonate, hot dilute KOH; abrasion resistance, very high. Used for bearings, bushings, compression springs,

burner plates, homogenizing valves, wire guides, turbine blades, pump gears, extrusion nozzles, gripper blocks, wire twister gears, valve seats, thread guides, cutters, shreading knives, etc.

TAYLOR FIBRE (Phenolic laminated plastics)—Taylor Fibre Co., Norristown, Pa.

Thermosetting: Laminated sheets, rods and strips for machining into parts. Abrasion resistance, medium and high; chemically resistant to most common solvents; max cont serv temp, 200 F; nonflammable; flexibility, high; dielectric str, 300 (volts per mil inst); ts, 7500 psi; comp str, 13,000 psi; in red, gray, black and white; shatterproof; sp gr, 1.25; opaque; bhn, 25. Used for electrical insulation and wherever high arc resistance is required.

Grade C-5: Canvas-base, melamine formaldehyde. Sheet and plate. Resistance to weak acids and most organic solvents, good; max cont serv temp, 275 F; flexibility, low; ts, 8000 psi; comp str, 38,000 psi; flex str, 16,000 psi; moisture absorb, low; in natural and white colors; shatterproof; sp gr, 1.4; opaque; Rock hdns, M 109. This is a plating barrel stock having high arc resistance and high acid chemical resistance.

TAYLOR PHENOL FIBRE (Laminated phenolic plastics—Taylor Fibre Co., Norristown, Pa.

Grade C: Sheet, strip, rods or tubes. Abrasion resistance, high; resists caustic solutions to 2% concentration, acid solutions to 10% concentration and common solvents; max cont serv temp, 200 F; slow burning; flexibility, low; dielectric str (volts per mil inst), 200 ts, 7500 psi; comp str 38,000 psi; elong, 2%; moisture absorp, low; in natural and black; impact strength, high; sp gr, 1.36; opaque; machinability, good; Rock hdns, M 108. For gears, cams, structural parts, etc.

Grade XX: Sheets, tubes and rods. Abrasion resistance, high; resists caustics up to 1% concentration; acids up to 5-10% concentration and common solvents; max cont serv temp, 225 F; slow burning; flexibility, low; dielectric str, 1/16 in. thick, (volts per mil inst), 500; ts, 9000 psi; comp str, 34,000 psi; trans str, 16,000 psi; elong, 1%; moisture absorb, low; in natural and black; shock resistance, medium; sp gr, 1.36; is opaque; machinability, good; Rock hdns, M 110. For terminal blocks, panels, washers, coil forms, etc.

Grade XP: Sheets and rods. Abrasion resistance, medium; not recommended for chemical application; max cont serv temp, 225 F; flex str (ASTM D 650-42-T) 15,000 psi; dielectric str, $\frac{1}{16}$ in. thick (volts per mil inst), 500; ts, 8000 psi; comp str, 22,000 psi; in natural and black; moisture absorp, low; sp gr, 1.36; opaque; machinability, good; bhn, 30. For washers, punchings, etc.

Grade G-5: Laminated sheets, rods and tubes. Abrasion resistance, medium; resists caustic concentration 1%, acid concentration 10-20%, and common solvents; max cont serv temp, 350 F; flex str (ASTM D 650-42T), 40,000 psi; dielectric str $\frac{1}{16}$ in. thick (volts per mil inst), 300; ts, 35,000 psi; comp str, 80,000 psi; in natural gray color; moisture absorp, low; sp gr, 1.95; opaque; machinability, fair; bhn, 40; temperature and arc resistance, high. For panel boards, structural parts.

Grade XXXP: Sheets, strips and plates. Abrasion resistance, medium; resists caustic concentration 1%, acid concentration 5-10%. and common solvents; max cont serv temp, 225 F; slow burning; flexibility, low; dielectric str, $\frac{1}{16}$ in. thick (volts per mil inst), 500; ts, 7000 psi; comp str, 25,000 psi; elong, 1%; moisture absorp, low; in natural and black; not shatterproof; sp gr, 1.30; opaque; machinability, good; Rock hdns, M 95-100. For switch bases, stators, condenser bases, etc.

Grade LE: Laminated sheets, rods and tubes, Fine weave fabric base. Abrasion resistance, high; resists caustic concentration to 2%, acid concentration to 10%, and common solvents. Max cont serv temp, 200 F; flex str (ASTM D 650-42T), 15,000 psi; dielectric str, $\frac{1}{16}$ in. thick (volts per mil inst), 400; ts, 8500 psi; comp str, 37,000 psi; in natural and black; moisture absorp, low; sp gr, 1.36; opaque; machinability, good; bhn, 36. For gears, cams, structural parts, etc.

Grade XXX: Laminated sheets and rods. Good resistance to most organic solvents; max cont serv temp, 280 F; flex str, 15,000 psi (ASTM D 650); dielectric str, 240-900 (volts per mil inst), depending on thickness; ts, 7000 psi; comp str, 32,000 psi; in natural color and black; moisture absorp, low sp gr, 1.34; opaque; machinability, good; Rock hdns, M 100. Used for switch bases, panels. high humidity applications, etc.

Grade XXP: Laminated sheets. Good resistance to most organic solvents; max cont serv temp, 225 F; flex str, 16,000 psi; (ASTM D 650); dielectric str, 250-950 (volts per mil inst), depending on thickness; ts, 8000 psi; comp str, 25,000 psi; impact str (Izod), 0.40 ft-lb edgewise; in natural, black and chocolate colors; moisture absorp, low; sp gr, 1.35; opaque; machinability, good; Rock hdns, M 95. For washers, condensers and switch rotor and stator insulation, etc.

Grade L: Linen base in sheet, rod, tube and plate. Abrasion resistance high; good resistance to most organic solvents; max cont serv temp, 280 F; dielectric str, 5-250 (volts per mil inst), depending on thickness; ts, 9000 psi; comp str, 35,000 psi; flex str, 20,000; sp gr, 1.35; opaque; machinability, good; Rock hdns, M 97. For fine-pitch small gears, cams, knobs, etc.

Grade A: Absestos paper-base phenolic laminate in sheets, rods, tubes and plate. Good resistance to weak acids and to most organic solvents; max cont serv temp, 290 F; flexibility, low; dielectric str, 50-225 (volts per mil inst), depending on thickness; ts, 8000 psi; comp str, 36,000 psi; flex str, 16,000 psi; moisture absorp, low; only in natural color; sp gr, 1.38; opaque; machinability fair; Rock hdns M 108. For armature slot insulation and various electrical appliance insulation.

Grade X: Laminated sheet, rods and tubes. Max cont serv temp, 270 F; flex str, 23,000 psi; dielectric str, 250-950 (volts per mil inst), depending on thickness; ts, 14,000 psi; comp str, 35,000 psi; impact str (Izod), 1.3 ft-lb flat, 0.50 ft-lb edgewise; in natural, black and chocolate colors; moisture absorp, high; sp gr, 1.34; opaque; machinability, good; Rock hdns, M 103; electrical properties, excellent. For insulating washers, bushings, coil forms, terminal boards, structural parts, etc.

Grade AA: Asbestos fabric, phenolic resin base. Sheet, rods, tubes and plate. Good resistance to work acids and most organic solvents; max cont serv temp, 290 F; flexibility, low; dielectric str, 50 (volts per mil inst); ts, 10,000 psi; comp str, 38,000 psi; flex str, 20,000 psi; moisture absorp, low; in natural color only; shatterproof; sp gr, 1.38; opaque; machinability, fair; Rock hdns, M 110; dimensional stability, good.. Used for armature wedges and rotor vanes.

Grades CE: Laminated sheets, rods and tubes. Abrasion resistance, low; good resistance to most organic solvents; max cont serv temp, 275 F; flex str, 17,000 psi (ASTM D 650); dielectric str, 100-500 (volts per mil inst) thickness; ts, 8000 psi; comp str, 36,000 psi; impact str (Izod), 2.3 ft-lb flat, 1.3 ft-lb edgewise; in the colors natural and black; moisture absorp, low; sp gr, 1.35; opaque; machinability, good; Rock hdns, M 105. For small gears, pinions, switchboard panels, circuit breaker and switch arms, etc.

TEFLON (Tetrafluoroethylene plastic)—E. I. du Pont de Nemours & Co. Inc., Polychemicals Dept. Wilmington, Del.

Tetrafluoroethylene polymer. Powder and tape and suspensoids. Formed into machine parts by special molding technique, by extruding and by machining. Abrasion resistance, medium; chemically resistant to anything except molten alkali metals; max cont serv temp, 500 F; dielectric str, 480 volts per mil inst; ts, 1800 psi; impact str (Izod), 2.5-4.5 ft.lb; natural (gray-white) and limited special colors; moisture absorp, zero; sp gr, 2.1-2.3; translucent and opaque; machinability, good; hardness, Durometer (ASTM D676-44T), D55; coef of thermal exp'n, 9.9 x 10^{-5} in/in/deg C. Outstanding combination of chemical resistance, electrical properties and high serve temperature. Also has unusually nonadherent surface. For chemical gaskets, mechanical seals, high-temperature, high-frequency insulation, nonadherent surfaces for food machinery, chemical equipment, etc.

TEGIT (Cold-molded plastics) — Garfield Mfg. Co., Garfield, N. J.

Tan colored, cold-molded plastics. Corrosion resistant; dielectric str, high; moisture absorp, less than 1%; max cont serv temp 300 F; impact-resistant; resists hot oil, boiling water and ordinary chemicals; will not shrink, crack, warp or deteriorate with age. Used for heavy-duty wiring devices and small insulated parts.

TEGO (Plastics resins)—Rohm & Haas Co., The Resinous Products Div., Philadelphia 5.

Synthetic resin adhesive, phenolic resin film, dry sheet. Moisture absorp, low; density, high. Used in manufacture of water-proof plywood for aircraft and marine use.

TELNIC BRONZE—Chase Brass & Copper Co., Waterbury 20, Conn.

Cu 98.3, Ni 1.0, P 0.2, Te 0.5. A hard high-strength forgeable age-hardenable, machinable bronze for general engineering structural uses.

TEMDCO (Hardsurfacing electrodes)—The MacDonald Co. Inc., Reno, Nev.

Eight types of hardsurfacing and build-up electrodes, hardnesses ranging from Rockwell C15 to 67.

TEMPALOY (Copper-aluminum-nickel alloy) — American Brass Co., Waterbury, Conn.

Alloys which respond to heat treatment. Abrasion resistant. Uses include piston rods, bearing applications, etc.

TENITE (Thermoplastic plastics) — Tennessee Eastman Corp., Kingsport, Tenn.

Tenite I: Cellulose-acetate base, thermoplastic. Granular and pellet form. In clear transparent and colors, plain, variegated, translucent and opaque; impact strength, high; high polish. For injection molding decorative and industrial products, also extruded in form of strips, rods, sheeting, and tubes.

Tenite II: Cellulose acetate butyrate base, thermoplastic. Granular and pellet form. Greater dimensional stability than cellulose acetate plastic because of lower moisture absorp; contains less plasticizer than cellulose acetate plastic and plasticizer used has greater retentivity; in clear transparent and colors; plain, variegated, translucent and opaque; impact strength, high; high polish. For injection molding of decorative and industrial products, also extruded in form of strips, rods, sheeting, and tubes.

TENSILASTIC (Rubber and rubber synthetics)—American Wringer Co. Inc., Woonsocket, R. I.

Hard and soft rubber and rubber synthetics for rolls and linings and covering of tank parts, etc. Any size from ½-in. long and ½-in. diam to 300 in. long and 44 in. diam; any density from dead hard to very soft; compounded to meet mechanical and chemical requirements; max cont serv temp, 180 F; flexibility, high; moisture absorp, low.

TENSILEND (Welding electrodes)—Arcos Corp., Philadelphia 43, Pa.

For welding low-alloy high-tensile steels.

TERNALLOY (Aluminum alloys)—Apex Smelting Co., Cleveland 5, and Chicago 12.

No. 6: Nominal composition; Mg 1.8, Zn 3.6, Mn 0.4, Cr 0.3. Ingots for sand, permanent-mold, precision castings. Typical properties, as-cast: Ts, 35-38,000 psi; ys, 20,-23,000 psi; elong, 4-12%; bhn, 70-75; sp gr, 2.76; nonmagnetic; weldability, good. For use where high strength, ductility, dimensional stability, and good machinability are required. Used primarily in as-cast condition.

No. 7: Nominal composition: Mg 2.1, Zn 4.2, Mn 0.4, Cr 0.3. Ingots for sand, permanent-mold, and precision castings. Typical properties, as-cast: Ts, 36-41,000 psi; ys, 23-26.000 psi; elong, 3-10%; bhn, 75-90; sp gr, 2.76; nonmagnetic; weldability, good. For use where high strength, ductility, dimentional stability, and good machinability are required.

No. 8: Nominal composition: Mg 2.4, Zn 4.6, Mn 0.4, Cr 0.3. Ingots for sand, permanent-mold, and precision castings. Typical properties, heat treated, for permanent-mold castings: Ts, 58,000 psi; ys, 52,000 psi; elong, 3.0%; bhn, 110; sp gr. 2.78; nonmagnetic; weldability, good. For use where high strength, ductility, dimensional stability, and good machinability are required.

TESCO (Electric steel castings) — Tonawanda Electric Steel Casting Corp., North Tonawanda, N. Y.

Grade B cast steel, low carbon; castings up to 300 pounds in weight. Ts, 70,000 psi (min); ys 36,000 psi (min); elong in 2 in., 24%.

TETON (Carbon-chrome tool steel)—Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

C 1.00, Cr 1.30 tool steel that is rather deep hardening and develops high compressive strength. For hardened machine parts subject to wear without severe shock. Usually hardened in oil.

TEXFOAM (Foam rubber)—The Sponge Rubber Products Co., Shelton, Conn.

Sheet, strip and forms molded to specification. Abrasion resistance, low; resistance to oils, poor; max cont serv temp, 150 F; inflammable; flexibility, high; moisture absorp, high; color, white; sp gr, 0.08-0.16; opaque; machinability, poor. For seat cushions, back rests, mattresses, upholstery and vibration cushioning.

TEXRUB (Rubber-like vinyl base material)—M. B. Price Associates, New York.

Thermosetting and thermoplastic: Laminated sheets, rods or tubes, for molding, casting,

machining, stamping and extruding into parts. Abrasion resistance, high; resist corrosion caused by water, gas, oils, alkalies, uric acid and 30% sulphuric acid and ozone; soften at 240 F; melt pt, 330 F; flexibility, good; ts, 2500 psi; black, white, gray, red, brown and green; translucent and opaque; shatterproof; sp gr, 1.26. For chemical tubing and piping, etc.

TEXTOLITE (Laminated plastics — General Electric Co., Chemical Dept., Pittsfield, Mass.

Sheets and laminates. Abrasion resistance, high; resistant to water, oils and most solvents; max cont serv temp, 250 C; flex str, 14,000 psi flatwise (ASTM D 48); dielectric str (volts per mil inst), 300; ts, 16,800 psi; compr str. 36,000 psi flatwise; imp str (Izod), 13 ft-lb per inch of notch; natural color only (gray white); moisture absorp, high; sp gr, 1.68; opaque only; machinability, fair; coef thermal exp'n, 1.01 x 10^{-5}. Outstanding heat and fire resistance. For motor and generator slot wedges, slot liners, terminal boards, panels, etc.

Phenol formaldehyde thermosetting plastic. Laminated rods and tubes. Abrasion resistance, high; resistant to water, oils, solvents and most acids; attacked by strong acids and alkalies; max cont serv temp, 120 C (some grades, 150 C); flex str, 16-34,000 psi (ASTM D 48); dielectric str (volts per mil inst), 78-950 at 25 C; ts, 9000-23,000 psi; compr str, 30,000-40,000 psi flatwise; imp str (Izod), 2.5 to 12.8 ft-lb per inch of notch; black, natural and chocolate; sp gr, 1.35-1.67; opaque; Rock hdns, M 93-119; coef thermal exp'n, 1.4 to 2.1 x 10^{-5}. For panels, supports, spacers, etc., in electrical and electronic apparatus.

THERMALLOY (Alloy cast steels)—Electro-Alloys Div., American Brake Shoe Co., Elyria, O.

Grade 85: Heat-resistant alloy as sand castings to specification. Ni 64-70, Cr 17-20, Si 1.2, Mn 0.75-1.25, C 0.45-0.65. Nonmagnetic; weldability, fair to good; resists corrosion by hot gases, except those high in sulphur; max cont serv temp, 2000 F. For heat treating boxes and trays, retorts, enameling furnace supports, furnace conveyor parts, burner parts, etc.

Grade 72: Heat-resistant alloy as sand castings to specification. C 0.45-0.65, Mn 0.75-1.25, Si 1-2, Cr 12-15, Ni 58-64. Properties, untreated: Ts 62-80,000 psi; ys 30-40,000 psi; elong in 2 in., 15-3%; bhn, 170-210; nonmagnetic; weldability, fair to good; resists corrosion by hot gases, except those high in sulphur; max cont serv temp. 2000 F. For general furnace parts, heat treating boxes and trays, retorts, enameling furnace supports, furnace conveyor parts, burner parts, etc.

Grade 50: Heat-resistant alloy as sand castings to specification. C 0.45-0.65, Mn 0.75-1.25, Si 1-2, Cr 15-18; Ni 34-37. Ts, 55-75,000 psi; ys, 32-55,000 psi; elong in 2 in., 20-4%; bhn, 150-195; nonmagnetic; weldability, fair to good; resists corrosion by hot gases except those high in sulphur; max cont serv temp, 2000 F. For furnace retorts, heat treating and carburizing boxes, burner parts, conveyor chain, furnace supports, etc.

Grade 40: Heat-resistant alloy as sand castings to specification. C 0.3-0.4, Mn 0.75-1.25, Si 1-1.75, Cr 26-28, Ni 10-13. Ts (untreated), 65-95,000 psi; ys, 36-55,000 psi; elong in 2 in., 30-4%; bhn, 170-260; nonmagnetic or weakly magnetic; weldability, good; resists corrosion by hot gases; max cont serv temp, 2000 F. For shafts, disks, beams, chain rollers and other heat-treating furnace parts; oil still tube supports; dampers and valves; paper-mill digester parts; burner tips and nozzles; rabble arms, and blades; furnace buggies; etc.

Grade 30: Heat-resistant alloy as sand castings to specification. C 0.25-0.35, Mn 0.75-1.25, Si 0.75-1.75, Cr 19-22, Ni 7.5-10. Properties, untreated: Ts, 75-100,000 psi; ys, 40-50,000 psi; elong in 2 in., 40-20%; bhn, 170-210; nonmagnetic or weakly magnetic; weldability, good; corrosion resistant to hot gases and corrosive liquids; max cont serv temp, 1600 F. For mine water and acid pump parts, chemical mixer parts, marine fittings, oil still supports, etc.

Grade 38: Heat-resistant alloy as sand castings to specification. C 0.3-0.4, Mn 0.75-1.25, Si 0.75-1.75, Cr 27-30, Ni 7-10. Properties, untreated: Ts, 85-110,000 psi; ys, 40-75,000 psi; elong in 2 in., 18-2%; bhn, 200-270; magnetic; weldability, good; resists corrosion by hot gases; max cont serv temp, 2000 F. Suitable for same type parts as Grade H.

Grade 47: Heat-resistant alloy as sand castings to specification. C 0.3-0.4, Mn 0.75-1.25, Si 1.25-2.25, Cr 24-27, Ni 19-22. Properties, untreated: Ts, 65-95,000 psi; ys, 40-70,000 psi; elong in 2 in., 25-12%; bhn, 160-195; nonmagnetic; weldability, good; resists corrosion by hot gases. For general furnace parts and carburizing containers.

Grade 28: Heat-resistant alloy as sand castings to specification. C 0.2-0.4, Mn 0.75-1.25, Si 0.75-1.75, Cr 26-29, Ni 3.0 max. Properties, untreated: Ts 65-95,000 psi; ys, 45-55,000 psi; elong in 2 in., 5-0%; bhn, 170-240; magnetic; weldability, fair; resists corrosion caused by hot gases. For lead pots, sintering bars, grate bars and tuyeres, roaster furnace rabble arms and blades.

THERMALLOY HC 250 (High-alloy cast steel)—Electro-Alloys Div., American Brake Shoe Co., Elyria, O.

A 26% chromium, high-carbon steel: Sand castings to specification. Annealed for machining; heat treatment necessary for max hardness. Properties, heat-treated: Ts, 90-130,000 psi; comp str, 400,000 psi; bhn, 700-750; magnetic; machinability, fair; weldability, poor; max cont serv temp, 1800 F; abrasion resistance, high. Used for rolls, pump parts, pug mill knives, roaster furnace blades, scrapers, conveyor wear plates, burner nozzles, molds, etc.

THERMOLAIN (Ceramic)—The Star Porcelain Co., Trenton 9, N. J.

Rods and tubes and special forms. Abrasion resistance, high; chemical resistance, high; max cont serv temp, 1500 F; dielectric str, 200 (volts per mil inst) at 20 C; flex str, 3100 psi; moisture absorp, medium; in white and black; not shatterproof; sp gr, 2.15; in opaque only; machinability, poor; coef thermal exp'n 0.0031 in./in./degree C.

THERMOPANE (Glass with metal edge seal)—Libbey-Owens-Ford Glass Co., Toledo, O.

Metal-to-glass edge-seal with dehydrated air spaces; furnished in flat units; abrasion resistance, high; resists corrosion; max cont serv temp, 150 F; flexibility, low; modulus of rupture, 6000 psi; nonflammable; moisture absorp, low; sp gr, 2.49; coef U for double-glass Thermopane with ¼-in. or ½-in. airspace, approx 0.65 to 0.58 triple glass with two ¼-in. air spaces, 0.47; transparent and translucent. For insulated observation windows.

THERMOPLAX (Cold-molding plastics)—Cutler-Hammer Inc., Milwaukee.

Asbestos base with bituminous or phenolic type of binder: Cold-molded into parts; max cont serv temp, 400-1000 F; nonflammable; dielectric str, 40-100 (volts per mil inst); resistant to corrosion; high polish; ts, 2000-4000 psi; moisture absorp, 2%. For electrical and heat insulation.

THINSTEEL (Carbon, alloy and stainless strip steel) — The Cold Metal Products Co., Youngstown, Ohio.

Most grades of carbon and alloy steels in strip form, including stainless steels. For property and application data, see "Stainless Steels" listing at end of this section.

THIOKOL (Synthetic rubber) — Thiokol Corp., Trenton, N. J.

Three types: Crude, corresponding to crude rubber, water dispersions for coatings, and liquid polymers; processed in manner similar to rubber; oil and solvent resistant. For hoses carrying oil or gasoline, gaskets, packing, pipeline rings, diaphragms, newspaper printing blankets, etc.

THOMASTRIP (Cold-rolled strip steel)—Thomas Steel Co., Warren, Ohio.

Electrocoated with nickel, copper, brass, zinc or chromium. Hot dipped tin and lead alloy. Lacquer coated in colors. Alloy strip steel. Annealed spring steel. Uncoated strip steel.

TIGER (High-leaded bronze)—National Bearing Div., American Brake Shoe Co., St. Louis 10.

Rough bars or billets, finished rods or bars, sand castings and centrifugal castings. Properties, unheat-treated: Ts, 30,000 psi; ys, 17,000 psi; elong in 2 in., 15%; bhn, 50-70 (500 kg); nonmagnetic; machinability, good; weldability, fair; abrasion resistance, medium. Used primarily as a backing material for bearings.

TIGERLOY (Alloy cast steel)—Massillon Steel Castings Co., Massillon, O.

Nickel-molybdenum: For shovel castings, gears, crane track wheels, castings for impact resistance, etc.

TIMKEN (Steels)—The Timken Steel & Tube Div., Timken Roller Bearing Co., Canton, Ohio.

All standard AISI types of alloy and stainless steels in standard forms. Also AISI carbon steels for mechanical tubing. For property and application data on stainless steels, see "Stainless Steels" listings at end of this section.

"91140" Steel: High carbon alloy type steel containing free graphite (0.40-0.70 graphite carbon). Hot rolled bars and billets, finished rods or bars, strip in straight lengths. Properties (heat treated): Ts, 160,000 psi; ys, 136,000 psi; elong in 2 in., 13%; bhn, 302; weldability, good; abrasion resistance, high; machinability, excellent (bhn, 217 max). For lathe ways, spindles, pump parts, valve tappets, etc.

TI-NAMEL (Vitreous enameling steel)—Inland Steel Co., Chicago 3.

Low-carbon titanium vitreous enameling steel usually in sheet or strip, but may be obtained in plates or bars. Produced primarily for its vitreous enameling characteristics. Can be used in hot and cold working, stamping, drawing, brazing, and welding. For food and dairy machinery, beverage machinery, washing machines, refrigerators, stoves, etc.

TI-NIC-O-SIL (Nickel-silver forging alloys)—Titan Metal Mfg. Co., Bellefonte, Pa.

No. 14: Cu 42, Ni 15, Zn balance. Has excellent white color; not quite as forgeable as No. 53. Ts, 105,000 psi; Rock hdns, B95.

No. 53: Cu 46, Ni 10, Zn balance. Ts, 92,000 psi; ys, 42,000 psi; elong, 26%; Rock hdns, B77. Forges with same ease as forging-quality brass. Close forging tolerances can be held. For forged parts requiring white color and good corrosion resistance combined with moderate strength.

No. 54: Nickel-silver cold-drawn rod, white color; Cu 46.85, Pb 2.50, Mn 2.00, Ni 11; balance Zn. Ts, 88,000 psi; ys, 68,500 psi; elong, 30%. Exceptional corrosion resistance; high strength; free machining; high polish. For hardware, valve parts, bottling machines, automobile accessories, electrical contacts, etc.

TIOGA (Alloy steel)—Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

C 0.68, Mn 0.60, Si 0.25, Cr 0.65, Ni 1.40 and Mo 0.20. Rock hdns, C64; nondeforming and shock-resisting; for clutch parts, cams, arbors, spindles, gears, shafts, guide pins, chuck jaws, keys, drawbench links and pins, stressed bolts and studs.

TISCO (Alloy steels)—Taylor Wharton Iron & Steel Co., High Bridge, N. J.

Manganese steel: C 1.00-1.40, Mn 11.0 min. Si 1.0 max, S 0.05 max, P 0.10 max. Sand castings. Ts, 80-120,000 psi; ys, 40-50,000 psi; elong in 2 in., 15-35%; bhn, 180-200; nonmagnetic; max cont serv temp, 300 F; abrasion resistance, high. For wearing parts for excavating, crushing and reduction machinery.

Timang: Manganese-nickel steel: C 0.60-0.80, Mn 13.0-15.0, Ni 2.75-3.25. Finished rods or bars, wire and plate, and sand castings. For arc welding. Ts, 135-155,000 psi; ys, 45-55,000 psi; elong in 2 in., 50-80%; endurance limit (completely reversed bending), 50,000 psi; bhn, 170-210; nonmagnetic; weldability, good; max cont serv temp, 500 F; abrasion resistance, high. For welding rods and abrasion-resisting plates and screens.

Alloy No. 80: Nickel-chromium-molybdenum steel. Sand castings: Properties, heat treated: Ts, 173,000 psi; ys, 165,000 psi; elong in 2 in., 8%; bhn, 350; magnetic; weldability, fair; abrasion resistance, high. For crushing parts, sand pumps, and various castings subjected to abrasion without shock.

Alloy No. 23X: Medium manganese-chromium-molybdenum steel. Sand castings to specification. Properties, water-quenched, heat-treated: Ts, 90-110,000 psi; ys, 68-90,000 psi; elong in 2 in., 20-30%; bhn, 210-260; weldability, good; abrasion resistance, medium. For structural applications where high strength and shock resistance are required.

TISCO No. 150 (High chrome cast iron)—Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

C 2.50-3.00, Ni 1.00-1.50. Cr 28.00-32.00. Sand castings to specification. Magnetic; machinability, poor; abrasion resistance, high.

TITAN (Bronze welding rods) — Titan Metal Mfg. Co., Bellefonte, Pa.

Alloy W-20: Brazing bronze. Ts (V-weld), 48,000 psi; Rock hdns (weld), B47-50; melt pt, 1623 F; shear str, 62,500 psi; fuming, single deoxidation; tinning, good; flow, very good.

Alloy W-60: Naval bronze. Ts (V-weld), 44-50,000 psi; Rock hdns (weld), B55-58; melt pt, 1625 F; shear str, 56,850 psi; fuming; single deoxidation; tinning, good; flow, very good.

Alloy W-21: Bronze. Ts (V-weld), 46-52,000 psi; Rock hdns (weld), B63-65; melt pt, 1615 F; shear str, 68,500 psi; low fuming, double deoxidation; tinning, good; flow excellent.

Alloy W-17: Manganese bronze. Ts (V-weld), 50-53,000 psi; Rock hdns (weld) B62-66; melt pt, 1620 F; shear str, 63,450 psi; low fuming, double deoxidation; tinning, good; flow, very good.

Alloy W-46: Wear well bronze. Ts (V-weld), 45,000 psi; Rock hdns (weld) B83-93; melt pt, 1590 F; low fuming, double deoxidation; tinning, good; flow, very good.

Yellow brass: Diecasting. Cu 62, Pb 1, Sn 0.5, Zn balance. Properties, unheat-treated: Ts, 58,000 psi; ys, 36,000 psi; elong in 2 in., 6%; Rock hdns, B60.

Cold heading wire: Brass containing Cu 65-70, Zn balance. For rivets, bolts, eyelets, fasteners, washer and binding head screws, inserts, studs, instrument assembly components, terminals, etc.

TITAN (Copper-base alloys)—Titan Metal Mfg. Co., Bellefonte, Pa.

Naval brass drawn rod. Cu 60, Sn 0.75, Zn balance. Ts, 69,000 psi; ys, 28,000 psi; elong, 32%; Rock hdns, B75; machinability, fair; corrosion resistant; good sea-water resistance.

Manganese bronze cold-drawn bar. Cu 59, Sn 0.75, Fe 1, Mn 0.40, Zn balance. Ts, 89,000 psi; elong, 21.5%; Rock hdns, B83; machinability, fair; corrosion resistance, good.

TITAN (Brass rods)—Titan Metal Mfg. Co., Bellefonte, Pa.

Large diameter brass rods for machining or forging. Diameters up to 10 in. and hexagons and octagons up to 4 in. Rectangles can be furnished in the extruded, drawn and machine straightened condition up to 3½-in. in diameter. Extruded and table straightened only, up to 5½ in. max diagonal for rectangles.

Nittany: Free turning brass. Cu 62.0, Pb 3.0, Zn 35.0. For screw machine work. Not recommended for forging.

Naval Brass (Leaded): Cu 59.0, Pb 0.95, Sn 0.75, Zn balance. Free machining, high tensile strength. Also suitable for hot pressing.

Logan Forging Brass: Cu 58.5, Pb 2.0, Zn balance. SAE 88. For hot forging.

Manganese Bronze (Leaded): Cu 59.25, Pb 0.60, Sn 0.90, Mn 0.40, Zn balance. For forging.

Nickel Silver (free turning): Cu 46.75, Pb 2.25, Mn 2.0, Ni 10.0, Zn balance. Highest tensile strength of materials listed here. Machinability, good. Has good white color.

TITANATES (Ceramic) — General Ceramics & Steatite Corp., Keasby, N. J.

Sheet, rods, tubes and plates. Abrasion resistance, high; max cont serv temp, 1700 F; nonflammable; flexibility, low; dielectric str, 185 (volts per mil inst); trans str, 15,000 psi; moisture absorp, low; in straw color; opaque; sp gr, 6-7. Used as dielectric material in manufacture of condensers.

T-LOYS (Steel castings)—Unitcast Corp., Steel Castings Div., Toledo 9, O.

No. 4: Abrasion-resistant, silicon-molybdenum steel with excellent hardening properties. For mining tools, wear plates, crusher plates and pinions.

No. 6: Air-hardening die steel of uniform machining qualities; long life under severe wear.

No. 34: C 0.30-0.37, Mn 0.70-0.85, Ni 0.70-0.95, Cr 0.50-0.70, Mo 0.18-0.25. Castings to meet 4B, 4C2, 4C3 Army specifications. Can be oil or water-quenched. General physical properties: Ts, 100,000 psi; ductility, high; bhn, 217-241; machinability, good.

No. 42: C 0.37-0.45, Mn 0.70-0.85, Ni 1.00-1.25, Cr 0.70-0.85, Mo 0.25-0.35. Higher strength and hardenability. Will oil quench to higher and deeper hardness. For wear plates, scarifier teeth, etc. Machinability, good at bhn, 220-260.

No. 131: C 0.22-0.28, Mn 0.7-0.8, Cu 1-1.2, V 0.04-0.08, Si 0.4-0.5. Castings. Ts, 90-100,000 psi; ductility, high. For use where high strength and ductility is desired rather than hardenability.

TOBIN (Bronze)—American Brass Co., Waterbury, Conn.

Cu 60, Zn 39.25, Sn 0.75. Abrasion-resistant. Uses include piston rods, boat shafting, condenser head plates, welding rods, seamless tubes, etc.

TOMBASIL (Copper-base alloys) — Ajax Metal Co., Philadelphia 23, Pa.

A: Cu 81.5, Si 4.8, Zn 13.7. Properties, untreated: Ts, 65,000 psi; ys, 40,000 psi; elong, 15%; bhn, 140; sp gr, 8.25; nonmagnetic; weldability, good.

Navy: Analysis in accordance with Navy Dept. Spec. 46B28. Cu 90, Si 5 max, Zn 5. Properties, untreated: Ts, 55,000 psi; ys, 20,000 psi; elong, 40%; bhn, 105; sp gr, 8.25; nonmagnetic; weldability, good.

TONCAN (Copper-molybdenum iron)—Republic Steel Corp., Cleveland 1, Ohio.

An open-hearth iron alloy with 0.40% min copper and 0.05% min molybdenum. Hot rolled, galvanized and galvannealed sheets; a ductile, rust resistant material for various sheet metal applications.

TOOL and DIE (Arc welding rod)—McKay Co., The, Pittsburgh 22, Pa.

Molybdenum high-speed tool steel arc welding electrode for hard surfacing of steel. Bhn of deposit, 550-620. Hard as deposited; can be annealed and rehardened; excellent abrasion resistance; holds good cutting edge. For hard surfacing cams, jaws, guides, rollers, cutting edges, etc.

TOOL-ARC (Welding electrodes) — Alloy Rods Co., York, Pa.

Electrodes for welding tool steels.

TOOLFACE (Welding rods and electrodes) — American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

C 0.8, Cr 4.0, Mo 9.0, W 1.5, V 1.0, Bhn, 575-675. Abrasion and impact resistant to 1000 F. For hardfacing only; martensitic steel deposits; magnetic; air hardening. Responds to heat treatment and can be forged. For hardfacing cutting tools, forging dies; for manufacture of composite tools and general hardfacing for extreme hardness and shock resistance.

TOOLWELD (Welding electrode)—Lincoln Electric Co., Cleveland.

Type 60: Coated arc welding electrode. Deposited hardness, 60-65 Rockwell C; hardness retained to 1000 F; deposit can be heat treated same as high-speed steel. For building hard, tough cutting edges on cold-rolled steel and for other applications requiring super-hardness.

Type A & O: Similar to above except used when greater impact resistance is desired. Oil and air hardening. Satisfactory on wide variety of tool steels.

TOPHET (Nickel-chromium alloys)—Wilbur B. Driver Co., Newark, N. J.

Type A: Approx. Ni 80 and Cr 20. Max cont serv temp, 2100 F. Wire and strip form. For electrical heating applications. Type C: Ni 60, Cr 15, balance Fe; resists heat to 1800 F. Wire and strip form. For electrical resistance and heating application.

TRANSFLEX (Thermoplastic plastics)—Irvington Varnish & Insulator Co., Irvington, N. J.

Polyvinyl chloride: Tubing and rods for extruding. When used as conduit permits quick identification of coded enclosed leads and location of wire breaks; unusual elongation facilitates stretching over lugs, splices and other projections; does not become brittle at temperatures as low as —58 F; max cont serv temp, 168 F; ts, 3000 psi; dielectric str, 1000 (volts per mil inst), (dry); 800 (volts per mil inst), (wet); for tubing wall thickness approximately 0.020-in.; sp gr, 1.2; moisture absorp, low. For moderately low temperature applications, wire insulation, conduit, etc.

TRANTINYL (Alloy steels)—Youngstown Alloy Castings Corp., Youngstown, O.

Sand castings. Abrasion resistance, high; Ductility, medium; tensile strength, high. For tools for tube and bar mills such as guide shoes, plugs, guides, etc.

TREMBRONZE (Strip bronze in coils)—The Miller Co., Meriden, Conn.

Properties, cold-worked: Ts, 91,000 psi; ys, 82,000 psi; elong in 2 in., 2%; Rock hdns, 90-96B; sp gr, 0.317; nonmagnetic; weldability, good; max cont serv temp, 350 F; abrasion resistance, medium. Used with excellent results in the manufacture of electrical control equipment, switches, clips, springs, etc.

TRENITE (Cast iron)—Trenite Corp., Trenton, N. J.

Sand castings to specification. Heat treatment unnecessary; ts, 45,000 psi; bhn, 275; magnetic; weldability, good; abrasion resistance, high.

TRENTWELD (Welded tubing)—Trent Tube Co., subsidiary Crucible Steel Co. of America, East Troy, Wis.

Welded stainless, high-alloy, Inconel and Monel tubing in sizes from ⅛-36 in. O.D.

TRI-CORE (Rosin-filled solder)—Alpha Metals, Inc., 363 Hudson Ave., Brooklyn 1, N. Y.

Various tin-lead solders for use wherever noncorrosive rosin fluxes are demanded. Also lead, tin, antimony, bismuth and white metals in pig or ingot, rough bars or billets, finished rods or bars, straight and coiled strip, tubing, wire, sheet, plate, powder metal and in permanent-mold castings and die castings.

TRI-MENSIONAL PROCESS (Decorative plastics)—Gemloid Corp., Elmhurst, L. I., N. Y.

Thermoplastic material suitable for paint spraying and plating to bring out decorative molded effects.

TRINDL SPEEDWELD (Mild steel welding rod)—Trindl Products Ltd., Chicago 16.

High-grade, deep-penetrating, mild steel, general-purpose shielded arc welding electrodes, for use with a-c transformer type machines or on straight polarity with d-c welders. Diameters from 1/16 to ¼-in.

TRITEX NO. 2 (Thermalized manganese steel)—La Salle Steel Co., Hammond, Ind.

C 0.40-0.48, Mn 1.35-1.65, P 0.040 max, S 0.24-0.33, Si 0.15-0.30. Finished bars for machining. Available both cold finished, ground and polished. Induction harden and quench, 1550 F, temper to desired hardness. Free from warpage. For leadscrews and key shafts, or, if heat-treated, gears and shafts.

T.R.S.-R.M. (Alloy tool steel)—Amalgamated Steel Corp., Cleveland 5, O.

Special analysis tool steel. Rough bars or billets, finished rods or bars, and special forgings. Properties, unheat-treated: Ts, 140,000 psi; ys, 126,000 psi; elong in 2 in., 17%; magnetic; machinability, good; weldability, good; abrasion resistance, high. High resistance to impact fatigue, abrasion and distortion at operating temperature.

TRUALOY (Bronze and aluminum alloy castings)—True Alloys Inc., Detroit 9.

Aluminum bronze: Cu 86-89, Fe 2-3, Al 8-10. Sand and permanent-mold castings. Properties, untreated: Ts, 65,000 psi; ys, 28,000 psi; elong in 2 in., 20%; bhn, 135; weldability, good; abrasion resistance, high. For high strength, wearing surfaces under load and low speed.

Aluminum: Cu 3, Si 4, Al balance. Sand and permanent-mold castings. Properties, untreated: Ts, 26,000 psi; elong in 2 in., 2%; bhn, 85; weldability, good, resists corrosion caused by salt water; abrasion resistance, medium. For polished castings where high strength, hardness and lightness are required, and for pressure castings.

Bearing bronze: Sn 8-10, Pb 15, Cu balance. Sand and permanent-mold castings. Properties, cold-worked: Ts, 25,000 psi; ys, 12,000 psi; elong in 2 in., 8%; weldability, good; abrasion resistance, high. For bearings under load and low pressure.

Manganese bronze: Cu 60, Zn 24, Fe 2, Al 4. Sand and permanent-mold castings. Properties, cold-worked: Ts, 65,000 psi; ys, 12,000 psi; elong in 2 in., 20%; weldability, good; abrasion resistance, medium. For parts requiring high strength with high elongation.

Also produce castings from all SAE, AISI and ASTM castings specifications.

TRU-CON (Copper sand castings)—True Alloys Inc., Detroit 9.

Furnished to specification, heat treated. Properties heat-treated: Ts, 45,000 psi; ys, 20,000 psi; elong in 2 in., 15%; bhn, 120; nonmagnetic; machinability, good; weldability, fair; electrical conductivity, 80%. Used where hardness plus good conductivity are required.

TRUFLEX (Thermostat metals)—General Plate Div. of Metals and Controls Corp., Attleboro, Mass.

Sheets or strips in long lengths, flattened and coiled, or cut to length; spiral, helix or double-helix coils; also fabricated parts, and welded or riveted subassemblies with solid-silver or laminated electrical contacts or mounting brackets. For control or indication of temperature and for compensating movement required in assemblies due to changes in temperature.

TRU-SIZE (Plastics tubing)—Yardley Plastics Co., Columbus, O.

Thermoplastic plastic tubing of the following base: Cellulose acetate, cellulose acetate butyrate, ethyl cellulose, methyl methacrylate, polystyrene and vinyl chloride acetate. In all colors. For vacuum cleaners, electrical equipment, sight gages, etc.

TUBE STOODITE (Hardfacing alloy)—Stoody Co., Whittier, Calif.

Crushed, controlled mesh size alloy particles contained in mild steel tubular rod. Composition: Chromium, manganese, zirconium,

silicon, carbon, and iron. Properties: Rock hdns, C58; sp gr 7.45; melt pt 2275 F; ts, 60,000 psi; abrasion and impact resistance, good. Excellent for hardfacing farm tools.

TUBE TUNGSITE (Welding rods and electrodes)—American Manganese Steel Div. American Brake Shoe Co., Chicago Heights, Ill.

Pure tungsten carbide in mild steel tubes. Various particle size ranges coarser than 40 mesh. Extremely abrasion resistant. For hardfacing oil-well and earth-drilling equipment; also applications requiring a serrated edge such as rotary drill bits, dredge cutter heads, scraper blades, sand plows, reamers, rock bits, scarifier teeth, shale planer knives, etc.

TUFALOY (Alloy steel castings)—Fort Pitt Steel Castings Div., McKeesport, Pa.

Intermediate manganese or manganese-molybdenum cast steel. Ts, 72-165,000 psi; ys, 40-140,000 psi; elong in 2 in., 31-14%; bhn, 153-302; max cont serv temp, 1100 F. For application where resistance to shock, abrasion and high pressures and temperatures are principal consideration.

TUF-FLEX (Tempered plate glass) — Libbey-Owens-Ford Glass Co., Toledo, O.

Polished plate glass heat tempered, in sheet and laminated form. High resistance to corrosion by moisture and all common acids except hydrofluoric acid; max cont serv temp, 550 F; flexibility, medium; dielectric str, 0.204 kilovolts per mil; modulus of rupture, 30,000 psi; not shatterproof but 4-5 times stronger than plate glass; produced in clear and colors; sp gr, 2.49. For machine guards, observation and inspection windows, sight glasses, gage glasses, etc.

TUF-STUFF-324E (Aluminum-bronze)—Mueller Bros. Co., Port Huron, Mich.

Cu 89, Al 10, Fe 1. Finished rods or bars. Ts, 85-95,000 psi; ys, 55-80,000 psi; elong in 2 in., 12-25%; Rock hdns, B85-93; highly resistant to acids and alkalies. Used where high strength and corrosion resistance are required and where excessive hardness is not a factor. For valve seat inserts, valve guides, airplane engine parts, etc.

TUFTEST (Cast iron) — The Medart Co., St. Louis.

For parts subject to excessive abrasion such as guiding disks; machinability, good.

TULOX (Thermoplastic tubing)—Extruded Plastics Inc., Norwalk, Conn.

A: Cellulose acetate thermoplastics. Tubing to full range of brilliant colors; transparent, translucent and opaque; odorless and tasteless. More rigid than EC and TT types; max cont serv temp, 160 F; ts, 4-600 psi; sp gr, 12.8.

EC: Ethyl cellulose thermoplastic, rigid. Tubes. Abrasion resistance, medium; impact strength at low temperature, high; transparent colors, translucent, opaque, no crystal clear. Tubular parts for use where high impact strength is required over a range of —40 F to 150 F.

TT: Cellulose acetate thermoplastic tubing. Extruded in sizes from 0.100-2½ in. OD; 42 sizes available from stock; abrasion resistance, medium; max cont serv temp, 160 F; flexibility, low; ts, 4-5000 psi; moisture absorp, low; sp gr, 1.2; shatterproof; transparent, translucent opaque; machinability, good. For use as gage glasses, separators and small machine parts produced on screw machine, etc.

TUNGROD (Welding rods and electrodes) — American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

Pure tungsten carbide in mild steel tubes. Various particle ranges 40 mesh and finer. Extremely abrasion resistant. For hardfacing earth-working, drilling and scraping equipment. Excellent for hard-facing thin edges such as coal cutter bits, core cutters, cane knives, plow shares, cultivator spades, etc.

TUNGSITE (Tungsten-carbide inserts) — American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

Pure tungsten carbide and cobalt bonded carbide. Available in various shapes.

TUNGWELD (Welding electrode)—Lincoln Electric Co., Cleveland 1, O.

Arc welding electrode that produces a deposit of tungsten carbide in alloy steel matrix. Suitable for hard facing materials where extremely severe abrasion is encountered such as oil-well tool joints, drilling bits, augers, etc.

TURBO (Plastics)—William Brand & Co., New York 10.

Vinyl chloride acetate and polyethylene thermoplastic rods, tubes and shapes. Max cont serv temp, 221 F; dielectric str, high; all NEMA colors; transparent, translucent and opaque.

Varnished cambric tubing, saturated sleeving. Max cont serv temp, 221 F; dielectric str, up to 1800 volts per mil; all NEMA colors; opaque only. For electrical insulation.

TURBO (Varnished insulating materials)—William Brand & Co., New York 10.

Varnished cotton, glass tubing, plastics extruded tubing, varnished cloth, tapes, and mica. Max cont serv temp, 180 F; nonflammable; flexibility, high; dielectric strength, 1000 (volts per mil inst); moisture absorp, low. Conforms to ASTM standards. For electrical insulation.

Wire, plastic insulated; overbraided-jacketed with cotton, rayon or glass yarn; lacquered.

TWINDOW (Insulating glass)—Pittsburgh Plate Glass Co., Pittsburgh 19.

Prefabricated glass units of two or more pieces of glass enclosing small hermetically sealed air space. Hollow aluminum tubing separates pieces of glass. Entrapped air at atmospheric pressure. Entire edge of each unit encased in stainless steel channel. Sizes to specification.

TYER (Molded rubber)—Tyer Rubber Co., Andover, Mass.

Natural and synthetic rubbers, custom molded to meet customers' specifications.

TYGOFLEX 40 (Thermoplastic plastics)—United States Stoneware Co., Akron 9.

Liquid form for injection and compression molding, casting and extruding. Properties, as molded: Ts, 900 psi; durometer hardness (Shore A) 40 plus or minus 2; sp gr, 1.15; ultimate elongation, 400%; permanent set, 25%; water absorp, 1.5%. Used as coating on metals, ceramics, glass, heat-resistant plastics, as well as for molding and casting into parts.

TYGON (Thermoplastics plastics)—United States Stoneware Co., Akron 9.

Flexible or rigid sheets, tubing, rods, or in liquid form. Molded cast or extruded. Abrasion, impact and corrosion-resistant, unaffected by oil, gasoline, water; nonaging; high dielectric and tensile strength. Transparent, translucent or opaque; in colors. Nontoxic. For molded machine parts, gaskets, tubing, etc.

TY-LOY (Abrasion-resistant metal)—W. S. Tyler Co., Cleveland.

Special composition metal resistant to abrasive action. Wire screens withstand severe abrasive conditions. For various sizes of square mesh and oblong-opening screens.

UFORMITE (Plastics resins)—Rohm & Haas Co., The Resinous Products Div., Philadelphia 5.

Synthetic resin adhesive, urea-formaldehyde: Powder form; moisture absorp, low; density, high. Used in manufacture of waterproof plywood for aircraft and marine use.

U-LOY (Copper-bearing steel)—Republic Steel Corp., Cleveland 1, Ohio

A low carbon steel with 0.20% min copper. Hot rolled, galvanized and galvannealed sheets; good corrosion resistance.

ULTRA-CUT (Bessemer rod)—Bliss & Laughlin Inc., Buffalo, N. Y.; Harvey, Illinois; Mansfield, Mass.

High-sulphur bessemer screw stock in cold-finished bars. For miscellaneous automatic screw machine parts.

ULTRON (Plastics)—Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Polyvinyl chloride, polyvinyl acetals, copolymers and vinyl butyral. Film, rigid sheets, resins, dispersions and compounds. Physical form varies from hard, rigid to elastomeric. Wide range of colors including transparents, translucents and opaques. Variety of surface finishes; excellent mechanical properties; unaffected by common weak acids and alkalies; in rigid forms excellent dimensional stability and nonflammable.

UNIMETAL (Welding rod) — Unimetal Co., Franklin, Pa.

Zinc-base welding rod for use in joining white metals or aluminum. For oxyacetylene welding of such items as molds, patterns, die castings, etc.

UNISORB (Noise and vibration damping materials)—The Felters Co., Boston 11.

A special material for simplifying anchoring of machinery and equipment on all types of floors. Absorbs from 60 to 85% of transmitted vibration and noise. Pads grip machine feet on top, floor on bottom; no other anchoring devices necessary. Holding strength, 1500 lb/sq ft (min); petroleum-resistant.

UNITED AMERICAN (Babbitt)—United American Metals Corp., Brooklyn 22, N. Y.

Government genuine babbitt: Bars. Properties, cold-worked: Ts, 7100 psi; compr str, 18,250 psi; ys, 7700 psi; elong in 2 in., 0.015%; bhn, 28.3. For heavy-duty high-speed engines.

Diesel machine genuine babbitt: Bars. Properties, cold-worked: Ts, 9760 psi; compr str, 11,740 psi; ys, 7700 psi; elong in 2 in., 0.11%; bhn, 24.8. For diesel type marine engines.

Manganese babbitt: Bars. Properties, cold-worked: Ts, 11,400 psi; compr str, 19,450 psi; ys, 8000 psi; elong in 2 in., 0.015%; bhn, 21. For general heavy service.

UNITED WIRE (Wire and tubing)—United Wire & Supply Corp., Providence 7, R. I.

Tubing and wire of nonferrous metals such as copper, brass, nickel, silver, aluminum, etc. In commercial grades.

UNIVAN (Alloy steel castings)—Union Steel Castings Div., Blaw-Knox Co., Pittsburgh 1.

C 0.30, Mn 1.00-1.20, Si 0.35, Ni 1.40-1.60, V 0.12, P 0.05 max, S 0.05 max. Sand castings to specification. Properties normalized and drawn: Ts, 90,000 psi; ys, 60,000 psi; elong in 2 in., 25%; impact str (Charpy), 30 ft-lb min. at room temp; bhn, 185-190; magnetic; machinability, good; weldability, good; abrasion resistance, high. For all castings where toughness, strength and resistance to rapid temperature changes or shock are required, such as charging boxes, charging peels, locomotive wheel centers, locomotive crossheads, etc.

UNIVAN "C" (Alloy steel castings) — Union Steel Castings Div., Blaw-Knox Co., Pittsburgh 1.

C 0.35-0.45, Mn 1.25-1.45, Si 0.35, Cr 0.50, Mo 0.20, P 0.05 max, and S 0.05 max. Sand castings to specification. Properties, normalized and drawn: Ts, 85,000 psi; ys, 55,000 psi; elong in 2 in., 22%; impact str (Charpy), 25 ft-lb min. at room temp; bhn, 195-200; magnetic; machinability, good; weldability, good; abrasion resistance, high. For all castings where resistance to wear is important, such as coupling boxes, spindles, gears, etc.

UNIVERSAL (Porcelain) — The Universal Clay Products Co., Sandusky, O.

Ceramic-base porcelain material for molding into parts. Resists corrosion caused by acids, climatic exposure and fumes, with the exception of hydrofluoric acid; max cont serv temp, 500 F; moisture absorp, low; in color; sp gr, 2.3-2.5; opaque. For use in electric insulation.

USALITE 1350 (Ceramic)—Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.

Rods and tubes. Max cont serv temp, 2400 F; nonflammable: flexibility, low; ts, 7000 psi; compr str, 30,000 psi; flex str, 5000 psi; moisture absorp, medium; in white; opaque; sp gr, 2.3. For use in pyrometers, etc.

U. S. RUBBER (Natural and synthetic)—U. S. Rubber Co., New York 20.

Sheet, strip, rods or tubes, plate and fluid for molding, stamping, or extruding. For hose, belting, packing, ducts, wire and cable and vibration absorbers. Properties to specification.

U · S · S (Sheet steels)—Carnegie-Illinois Steel Corp., Pittsburgh 30, Tennessee Coal, Iron & Railroad Co., Birmingham 2.

Paintbond: Galvanized steel sheets for stamping and forming into cases, cabinets, etc.

Galvannealed: Galvanized steel sheet for stamping and forming into cases, cabinets, air ducts, dust collectors, etc.

Vitrenamel: Sheet for porcelain enameled jackets, casings, trays, cabinets, etc.

Electrical Sheets: Also strips, for parts requiring electrical properties.

Copper steel: Strip, sheet and plate for general sheetmetal parts.

Hot-Rolled Sheets and Strip: For sheetmetal parts where finished appearance is of secondary importance.

Cold-Rolled Sheet: For sheetmetal parts requiring severe forming and where good finish is important.

Also Galvanized sheets and Long Terne sheets.

U · S · S AMERCUT (Carbon and alloy steels)—American Steel & Wire Co., Cleveland.

Cold finished carbon and alloy steel bars

either cold drawn, annealed, normalized, spheroidized or quenched and tempered to meet various combinations of definite physical, magnetic, corrosion-resistant or machinability properties specifications.

U·S·S AMERICAN QUALITY (Carbon and alloy steels)—American Steel & Wire Co., Cleveland.

Carbon steels and alloys in the form of cold rolled strip, manufacturer's wire and springs.

U·S·S AR STEEL (Abrasion resisting steel)—Carnegie-Illinois Steel Corp., Pittsburgh; Columbia Steel Co., San Francisco; and Tennessee Coal, Iron & Railroad Co., Birmingham 2.

C 0.35-0.5, Mn 1.5-2, P 0.05 max, S 0.55 max, Si 0.15-0.3. Bars, sheets, strip, plates and shapes. Abrasion resistance, high; bhn, approx 200-275 as rolled; heat-treated, 350-450. For wear resisting surfaces.

U·S·S CARILLOY (Standard alloy steels)—Carnegie-Illinois Steel Corp., Pittsburgh; Columbia Steel Co., San Francisco; and Tennessee Coal, Iron & Railroad Co., Birmingham 2.

Alloy steels in all standard AISI and SAE grades.

U·S·S COR-TEN (High-strength steel)—Carnegie-Illinois Steel Corp., Pittsburgh; Columbia Steel Co., San Francisco; American Steel & Wire Co., Cleveland; and Tennessee Coal, Iron & Railroad Co., Birmingham 2.

C 0.12 max, Mn 0.2-0.5, P 0.07-0.15, S 0.05 max, Si 0.25-0.75, Cu 0.25-0.55, Cr 0.50-1.25, Ni 0.65 max. Bars, sheets, strip, plates, structural and bar shapes, for hot and cold forming, welding, riveting, etc. Resists atmospheric corrosion four to six times as well as plain carbon steel; abrasion resistance, good; yp, 50,000 psi min; ts, 70,000 psi min; good ductility; weldability, good. For lightweight construction where atmospheric corrosion-resistance is a major factor; structural and body members on mobile equipment.

U·S·S MAN-TEN (High-strength steels)—Carnegie-Illinois Steel Corp., Pittsburgh; Columbia Steel Co., San Francisco; and Tennessee Coal, Iron & Railroad Co., Birmingham 2.

C 0.25 max, Mn 1.1-1.6, P 0.045 max, S 0.05 max, Si 0.3 max, Cu 0.2 min. Bars, sheets, strip, plates, structural and bars shapes for hot and cold forming, welding and riveting. Corrosion-resistant; abrasion resistance, high; yp, 40,000 psi min; ts, 65,000 psi, min. For lightweight construction where atmospheric corrosion resistance is not a major factor.

U·S·S MX (Free-machining bar stock)—Carnegie-Illinois Steel Corp., Pittsburgh, Pa.

C 0.13 max, Mn 70-1.00, P 0.07-0.12, S 0.24-0.33, (B-1113). Hot-rolled bars. Machinability, excellent. For use in multiple-spindle automatic screw machines where speed of machining and high finish are required.

U·S·S PREMIER (Spring wire)—American Steel & Wire Co., Cleveland; Columbia Steel Co., San Francisco; Tennessee Coal, Iron & Railroad Co., Birmingham 2.

Special processed steel spring wire having high yield and fatigue strength.

U·S·S SHELBY (Mechanical tubing)—National Tube Co., Pittsburgh; Columbia Steel Co., San Francisco 6.

Many different grades from low carbon steel to the stainless grades of alloy steel suitable for various uses in the automotive, aircraft and machine tool industries. Sizes up to 10¾ in. OD according to grade and intended use. Made to AISI standards and various industry and government specifications.

U·S·S STAINLESS (Stainless steels)—American Steel & Wire Co., Cleveland; Carnegie-Illinois Steel Corp., Pittsburgh 30; Columbia Steel Co., San Francisco; National Tube Co., Pittsburgh; Tennessee Coal, Iron & Railroad Co., Birmingham 2.

Stainless steels in standard forms to AISI Specs. For type, property and characteristics data see "Stainless Steels" listing at end of this section.

"U. S." STANDARD (Chemical stoneware)—United States Stoneware Co., Akron 9.

Wide range of shapes and sizes. Resists all corrosives except hydrofluoric acid and hot caustics; hard, durable. For fabrication into tanks, etc., and for lining exhausters and acid-pumps.

U·S·S TRI-TEN (Steel)—Carnegie-Illinois Steel Corp., Pittsburgh; Columbia Steel Co., San Francisco; and Tennessee Coal, Iron & Railroad Co., Birmingham 2.

C 0.25 max, Mn 1.40 max, P 0.045 max, S 0.05 max, Si 0.25 max, Cu 0.30-0.60, Ni 0.50-1.00. Rough bars or billets, finished rods or bars, strips (coiled), sheets, plates and structural shapes, for hot and cold forming, riveting, etc. Resistance to corrosion 3 times that of plain carbon steel; abrasion resistance, good; ductility, good; weldability, good; yp, 50,000 psi min; ts, 70,000 psi min. For lightweight construction where atmospheric corrosion and welding are of major importance.

UTALOY (Alloy steel castings)—American Foundry & Machine Co., and Eimco Corp., The, Salt Lake City, Utah.

High carbon chrome-molybdenum steel castings to specifications. Properties, heat-treated: Ts, 175,000 psi; bhn, 350; sp gr, 7.8; magnetic; machinability, fair; weldability, fair; max cont serv temp, 1100 F; abrasion resistance, high. For ball and rod mill liners.

UTICA (Aluminum and magnesium castings)—Utica Radiator Corp., Utica 2, N. Y.

Sand castings of various aluminum and magnesium alloys supplied to specification.

VALITE (Laminating resins)—Valite Corp., New Orleans 12.

No. 8123: Thermosetting. For impregnating duck, paper, etc. For housings, silent gears, mountings, switches, etc.

No. 1366: Thermosetting, water soluble. For bonding glass and cellulose fibers, stiffening pulp, etc.

VANADIUM PERMENDUR (Electrical steel)—Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

High-density, high-saturation alloy of cobalt, vanadium and iron. Cold rolled strip, bars and laminations. High magnetic saturation. For diaphragms, high density dc cores.

VASCO PREALLOYED STAINLESS STEEL POWDER—Vanadium-Alloys Co., Latrobe, Pa.

Conforms to AISI Type 302 stainless steel. See stainless steel page at end of this section.

VECTOLITE (Magnet material)—Carboloy Co. Inc., Detroit, Mich.

Nonmetallic, nonconducting magnet material; hardened sintered combination of iron oxide and cobalt oxide mixed when still in powder form. Light weight; nonconductive properties prevent electrical losses. High coercive force or resistance to demagnetizing forces.

VELBUNA (Gasket material)—The Vellumoid Co., Worcester 6, Mass.

A special fibre and synthetic rubber composition made with both Buna N (oil-resistant) and Buna S (non-oil-resistant) for a wide variety of applications where a fairly compressible material is required. Especially suitable for use where weathering, corrosion and intermittent wet and dry conditions are factors. Compressibility 30-35% (load 1000 psi). 85-90 Durometer Hardness Shore "A"—10 seconds. Temperature limit approximately 275 F. Noncorrosive to aluminum, magnesium, steel, chromium, copper or other alloys. Thicknesses $\frac{1}{64}$", $\frac{1}{32}$" and $\frac{1}{16}$" single ply.

VELLUMOID (Sheet packing)—The Vellumoid Co., Worcester 6, Mass.

A vegetable fiber base composition impregnated with glue and glycerine. For all-around general gasket requirements; recommended for use under ordinary flange conditions for oils, gasoline, greases, etc., or constant water service where temperatures encountered do not exceed approximately 300 F. Does not become hard or brittle upon drying; ts, 2000 psi minimum.

VELLUTEX (Gasket material)—The Vellumoid Co., Worcester 6, Mass.

Composed of a special fiber base saturated with an impregnant of specially prepared oils and resins. Max cont serv temp, 250 F; especially suitable for gaskets in contact with nonferrous metals and their alloys, particularly where corrosion is a factor and where intermittent wet and dry conditions are prevalent; not affected by acids and alkalies up to 10% concentration, gasoline, animal, vegetable and mineral oils, alcohol, Freon, methyl and ethyl chlorides, salt solutions, etc. Compressibility, 18-22% of original thickness when compressive force of 400 psi is applied. Ts, 1500 psi for thicknesses up to $\frac{1}{32}$ in. (minimum); resists crushing at flange pressures up to 8000 psi. Supplied in thicknesses from $\frac{1}{64}$-in. to 0.050-in.

VELOX (Bearing Bronze)—Gilbert Brass Foundry Co., St. Louis 15, Mo.

Cu 77, Sn 8, Pb 15. Sand castings. Properties, unheat-treated: Ts, 35,000 psi; ys, 15,000 psi; elong in 2 in., 16%; bhn, 55 (500 kg); sp gr, 9.1; nonmagnetic; machinability, good; weldability, poor; abrasion resistance, medium. General-purpose bearing bronze highly favored by railroads and users of heavy-duty bearings where long life and maximum efficiency are imperative.

VELVETOUCH (Friction products)—The S. K. Wellman Co., Cleveland 3, O.

All-metal friction products consisting of a combination of various powdered metals such as copper, tin, lead etc, compressed and fused with a solid steel backing. Applications include clutch plates, facings and brake linings.

VERTEX (Arc welding electrode)—Metal & Thermit Corp., New York 5.

For general machine part use. Weld deposit: Ts, 62-70,000 psi; ys, 52-60,000 psi; elong in 2 in., 22-30%

VIBRIN (Polyester thermosetting resins)—Naugatuck Chemical Div. of United States Rubber Co., Naugatuck, Conn.

For laminating, molding and casting.

V 108: Sp gr, 1.25; flex str, 13,000 psi; mod elast on flexure, 418,000 psi; Rock hdns, L 118; ts, 10,700 psi; impact str (notched Izod), 0.25 ft-lb; power factor (10^6 cycles), 0.017.

V 112: Sp gr, 1.28; flex str, 12,500 psi; mod elast on flexure, 580,000 psi; Rock hdns, L 121; ts, 7,700 psi; power factor (10^6 cycles), 0.013.

V 121: Sp gr, 1.16; ts, 1,800 psi; power factor (10^6 cycles), 0.033.

V 132: Sp gr, 1.32; flex str, 12,000 psi; mod elast on flexure, 379,000 psi; Rock hdns, L 119; impact str (notched Izod), 0.26 ft-lb; power factor (10^6 cycles), 0.023; dielectric str (short time), 385 volts per mil.

V 133: Sp gr, 1.37; Rock hdns, L 120.

V 142: Sp gr, 1.42; flex str, 13,000 psi; mod elast on flexure, 311,000 psi; Rock hdns, L 115; ts, 6,300 psi; impact str (notched Izod), 0.25 ft-lb; power factor (10^6 cycles), 0.009; dielectric str (short time) 351 volts per mil.

VICTOLENE (Synthetic rubber)—Victor Mfg. & Gasket Co., Chicago.

Thermosetting: Sheets and stampings, for molding into parts. Resists corrosion caused by oil, gasoline, kerosene, salt water and antifreezers; max cont serv temp, 250 F; flexibility, high; ts, 350 psi; moisture absorp, medium; inflammable; in brown; shatterproof; sp gr, 1.12; opaque. For gasketing material, when compressed in position by light metal or plastic stampings; used for sealing fluids.

VICTOPAC (Asbestos-base sheet)—Victor Mfg. & Gasket Co., Chicago.

Compressed sheet packing with asbestos base for stamping or cutting by hand into parts. Corrosion resistance, high; flexible; ts, 2500 psi; heat-resistant; moisture absorp, low; nonflammable; impact-resistant; compr str, high. For gasketing and packing.

VICTOPRENE (Elastic plastics)—Victor Mfg. & Gasket Co., Chicago.

Thermosetting: Sheet or molded form. Sheets may be stamped and blanked into parts. Corrosion and heat resistant; ts, 1500 psi; moisture absorp, low; shatterproof. Used as a gasketing material.

VICTOR (Asbestos sheet)—Victor Mfg. & Gasket Co., Chicago.

Asbestos fiber base: Sheets for stamping or cutting into parts. Corrosion-resistant; flexible; ts, 300 psi; max cont serv temp, 700 F; nonflammable; sp gr, 0.9; compr str, high; insoluble; some resilience. For packing, thermal insulation, and vibration absorption.

Cork sheet: Vegetable bark in sheet form for stamping and cutting into parts. Corrosion-resistant; flexible; max cont serv temp, 180 F; moisture absorp, low; sp gr, 0.27; compr str, fair; resilient. For seals, vibration absorption.

VICTORITE (Fiber-base sheet)—Victor Mfg. & Gasket Co., Chicago.

Vegetable-fiber base sheet packing: For stamping or cutting by hand into machine parts. Flexible; ts, 3000 psi; max cont serv temp, 200 F; nonflammable; impact-resistant; sp gr, 0.675; comp str, 2000 psi; resilient. For gasketing and packing.

VICULOY (Beryllium Copper)—The Akron Bronze and Aluminum Co., Akron, O.

No. 1: Beryllium copper sand castings, heat-treated at foundry. Ts, 85-90,000 psi; ys,

60-70,000 psi; elong in 2 in., 4.12%; bhn, 200-220; electrical cond, 50-55; nonmagnetic; weldability, poor; abrasion resistance, medium; corrosion resistance equal to copper. For gears, pinions, flash welding dies, trolley shoes and wheels, boat shafting, welding wheels, marine hardware and fittings.

No. 2: Beryllium copper sand castings heat-treated at foundry. Ts, 45-50,000 psi; ys, 30-35,000 psi; elong in 2 in., 17-22%; bhn, 120-140; electrical cond, 65-70; nonmagnetic; weldability, poor, abrasion resistance, high; corrosion resistance equal to copper. For circuit breaker parts, current carrying terminals, sliding contacts, burner and current collecting nozzles, spot-welding tips and wheels, etc.

No. 3: Beryllium copper sand castings heat treated at foundry. Ts, 170,000 psi; ys, 120,000; psi, elong in 2 in., 2.8%; bhn, 370-400; electrical cond, 20-25; nonmagnetic; weldability, poor; abrasion resistance, high; corrosion resistance about same as copper. For gears, rocker arms, die molds, precision bearings and bushings, etc.

VIM (Leather)—E. F. Houghton & Co., Philadelphia 33.

For packings for hydraulically operated mechanisms. Max cont serv temp, 200 F; nonflammable; moisture absorp, low.

VIMLITE (Wire or plastics mesh re-enforced plastics)—Celanese Corp. of America, Plastics Div., New York 16.

Bursting strength (Mullen), over 150 psi; light transmission over 50%; good resistance to outdoor weather. Both are lightweight, will not support combustion. For machine guards, glazing, etc.

VINYLITE (Thermoplastic vinyl resins)—Bakelite Div. Union Carbide & Carbon Corp., New York.

Rigid sheets, flexible sheeting, flexible film, rigid and elastomeric molding and extrusion compounds, surface coatings, cloth coatings, textile treatments, adhesives and monofilaments. Can be formed, drawn, laminated, and bonded under moderate heat and pressure. In basic form, they are odorless, tasteless, nontoxic, and range from nonflammable to slow burning. Some have exceptional resistance to moisture and most chemicals. Strong and tough even at lower-than-freezing temperatures. Do not warp; have unusual dimensional stability.

Vinyl chloride-acetate resins: Both elastomeric and rigid products in many forms; vinyl acetate resins, adhesives and textile treatments; vinyl butyral resins, safety glass and cloth coatings; vinyl chloride resins, molding and extrusion compounds.

VISQUEEN (Thermoplastic plastics)—The Visking Corp., Terre Haute, Ind.

Polyethylene type: Sheets and tubes. Abrasion resistance, medium; not affected by strong or weak acids or alkalies, nor from organic solvents below 50 C; max cont serv temp, 212 F; flex str, 1500-1700 psi; ts, 1800-3000 psi; all colors from transparent water white to black; sp gr, 0.93; machinability, good. For packaging material, electrical insulation for special uses.

VISTANEX (Thermoplastic elastomer) — Enjay Co. Inc., New York 19.

Polyisobutylene. Crumb or bale form in several grades of medium weight low molecular weight is a semi-solid available in drums. Good resistance to ozone, acids and alkalies; dielectric str (volts per mil inst), 590; moisture absorp, low; sp gr, 0.91; light-colored; primarily used with other resins and rubbers. May be used alone for such products as tank linings, cements and adhesives, etc. Combined with natural rubber or GR-S, it may be used in such products as tire treads, high-voltage electrical insulation, adhesives, steam hose, belt coverings; combines with waxes for paper coatings.

VISTEX (Rubberized laminated felt)—American Felt Co., Glenville, Conn.

Hycar, Neoprene and Buna S types in sheets, strips or cut parts for stamping and machining. Abrasion resistance, high; chemical resistance, as specified; max cont serv temp, 300 F; nonflammable; flexibility, medium; ts, 2000 psi; comp str, 10,000 psi; flex str, high; elongation 20%; comp set, 40%; moisture absorp, low; gray, brown, black and red; opaque. Self-lubricating positive sealing material. For hydraulic packing washers, gasketing, seals, vibration and shock mounting.

VITREOSIL (Vitreous silica) — The Thermal Syndicate, Ltd., New York 17.

Fused silica tubing and rod in four qualities: with sand surface, glazed surface, satin surface (translucent), and transparent. Sand surface quality possesses resistance to the highest degree to extreme chemical and thermal conditions. Glazed surface material is preferable to sand surface tubing under vacuum or other conditions where a high degree of impermeability is required. Transparent material is highly transparent to ultraviolet light as well as to visible and to infra-red radiation. It is also stronger mechanically and highly impermeable, thus is used where vacuum tightness is required in sealed apparatus. All types are chemically and catalytically inert, offer high resistance to extreme thermal shock, unusual electrical resistivity, excellent thermal conductivity. Rods can be produced to special cross sectional shapes.

VITRIC-10 (Ceramic nonplastics)—United States Stoneware Co., Akron 9.

Powder form for casting into parts or as complete parts. Corrosion and heat-resistant (1000 F); nonflammable; in colors. For cementing and sealing.

VIX-SYN (Synthetic rubber)—E. F. Houghton & Co., Philadelphia 33.

Synthetic rubber, fabricated and homogeneous, in special molded shapes. Moisture absorp, low; opaque. For packings for hydraulically operated machines. Also "O" ring packings and gaskets.

VOLTRON (Thermoplastic plastics) — Industrial Synthetics Corp., Garwood, N. J.

Polyvinyl chloride base: Strips, rods or tubes. Abrasion resistance, high; chemical resistance, high to all inorganic acids and most other chemicals except ketones, esters, aromatic and chlorinated hydrocarbons; max cont serv temp, 158-194 F; self-extinguishing; flexibility, high; dielectric str, 1-2000 (volts per mil inst); ts, 1900-3000 psi (varying with different grades); elongation 330-435; moisture absorp, low; in clear, white, black, yellow, red, blue and green; transparent, translucent and opaque; sp gr, 1.19-1.25; shatterproof. For electrical insulation.

V-R (Cemented carbides) — Vascoloy-Ramet Corp., Waukegan, Ill.

Twenty grades available of tungsten-carbide bonded with various amounts of cobalt, with or without addition of tantalum and/or tungsten-titanium carbide. Trans rupture str, 180,000-325,000 psi; Rock hdns, A75-93; sp gr, 10.7 to 15.2; abrasion resistance, very high. For machinery parts requiring extreme hardness and wear resistance.

VULCOID (Electrical insulating material)—Continental-Diamond Fibre Co., Newark 23, Del.

Intermediate between vulcanized fibre and laminated phenolic plastics. Sheets, tubes, rods and parts. Machinability, excellent; brownish gray. For insulation of current carrying parts in electrical equipment.

VYCOR (Glasses)—Corning Glass Works, Corning, N. Y.

In general, glasses with coefficient of expansion less than 20 x 10^{-7}/°C. Blown, drawn, pressed products with wide range of chemical, physical, optical, electrical and mechanical properties.

W-30 (Powder metal)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

Contains 90% iron powder and 10% copper powder; ts, as pressed and sintered, 34,500 psi; ys, 27,000 psi; imp str (Izod), 2 ft-lb; Rock hdns, B 66; abrasion resistance, high; for gears, bushings, pawls, etc.

W-55-a (Powder metal)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

High copper content; pressed and sintered parts to specifications; ts, 21,000 psi; imp str (Izod), 3 ft-lb; Rock hdns, H 70; abrasion resistance, medium; for thrust washers, bearings, etc.

W-56 (Powder metals)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

Pressed and sintered parts of leaded bronze powder metal. Ts, 25,000 psi; impact str (Izod), 3 ft-lb; Rock hdns, H 70; machinability, good. Is self lubricating; used for gears, bearings, bushings, etc.

W-58 (Powder metal) — Powdered Metal Products Corp. of America, Franklin Park. Ill.

Pressed and sintered parts of powder metal composition containing 99% iron and 1% carbon. Ts, 16,000 psi; Rock hdns, B 30; machinability, fair. Used for gears, bearings, cams, etc.

W-100 (Iron-copper powder metals)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

Pressed and sintered parts of iron-copper powder metal to specification. Properties of 7.8 density material; Ts, 76-100,000 psi; ys, 75,000 psi; imp str (Izod), 3 ft-lb; Rock hdns, B 90; abrasion resistance, high. For gears, cams, pawls, etc.

WASHCOTE (Welding rods) — Harnischfeger Corp., Milwaukee 14, Wis.

Mild steel welding rods for joining structural steels. Ts of joints, 55-60,000 psi; ys, 40-45,000 psi. For applications requiring stable arc with little spatter and easily cleaned welds.

WAUKESHA Metals (Copper-nickel alloys) — Waukesha Foundry Co., Waukesha, Wis.

Copper-base, high-nickel content alloys, in 20 different grades: Sand castings for machining into parts. Also copper-free nickel alloys Nos. 50 and 53 to operate against stainless steels without galling. Ts, up to 105,000 psi; elong in 2 in., from less than 1 to 34%; bhn, (3000 kg), from 93 to 264; resist corrosion caused by dairy, food, beverage and canning products, and salt solutions. For all parts contacting dairy, food, beverage and cannery foods.

WEAR-ARC (Hardfacing electrodes) — Alloy Rods Co., York, Pa.

Hard surfacing electrodes which impart high impact strength and good abrasion resistance.

WEIRALEAD (Ductile sheets) — Weirton Steel Co., Weirton, W. Va.

Excellent welding characteristics. Tight, hot-dipped coating serves as a die lubricant and takes deep drawing successfully. Provides a satisfactory base for paint, lacquer or varnish.

WEIRZIN (Zinc-coated sheets and strip)—Weirton Steel Co., Weirton, W. Va.

High quality ductile steel with bonded coating, for deep drawing. Sheets 32½ in. wide (available in coils or cut lengths) down to ⅝-in. strip. Adaptable to a wide variety of uses where the protection of zinc coated material is required.

WELBRONCO (Nonferrous castings) — Wellman Bronze & Aluminum Co., Cleveland.

Copper-base, aluminum and magnesium sand castings to specification.

WELD-ARC (Welding electrodes)—Alloy Rods Co., York, Pa.

Electrodes for welding mild steels, high-carbon, high-sulphur and low-alloy, high-tensile steels.

WELDRAWN (Welded tubing)—Superior Tube Co., Norristown, Pa.

Cold-drawn to give properties of seamless. Certain grades of stainless, beryllium copper, nickel and Monel.

WELDWOOD (Resin-bonded plywood)—United States Plywood Corp., New York.

Phenol-formaldehyde and urea-formaldehyde: Thermosetting. Flexibility varies with thickness; splitproof; shatterproof; high tensile and dielectric strength. Waterproof and water-resistant grades in all woods; molded shapes, tubular and curved.

WELLCAST (Nonferrous castings) — Wellman Bronze & Aluminum Co., Cleveland.

Copper-base, aluminum and magnesium sand castings to specification.

WEL-MET (Powder metal parts)—Wel-Met Co., The, Kent, O.

Sintered iron: Fe 90, Cu 10. Properties, 0.21 lb/cu in. density material: Ts, 35,000 psi; compr str, 45,000 psi; bhn, 60-80; sp gr, 6.0; hardenable; self-lubricating when oil filled. For parts which are difficult or expensive to machine.

Sintered bronze: Cu 85, Sn 8, Pb 5. Properties, 0.22 lb/cu in. density material: Ts and compr str, 12,000 psi; bhn, 30; sp gr, 6.0; retains 26% oil by volume. For self-lubricating bearings.

Filter materials: Produced to suit requirements.

Magnets: Plastic bound oxides. For permanent magnets of intricate shapes and where close tolerances are required.

Sintered leaded iron: Fe 90, Pb 9. Properties, 0.22 lb/cu in. density material: Ts, 15,000 psi; compr str, 20,000 psi; bhn, 40; sp gr, 6.0; retains 26% oil by volume. For self-lubricating bearings.

WESTERN (Copper-base alloys)—Western Brass Mills Div. of Olin Industries Inc., East Alton, Ill.

Copper-base alloys (Western Brass, Western Copper, Western Super-X Phosphor Bronze, Western Super-X Nickel Silver): Straight and coiled strip and sheet. For machining, hot and cold working, stamping, drawing, arc, gas and resistance welding, and brazing. Electrical properties, good.

WESTERNITE (Iron and steel castings) — Western Foundry Co., The, Chicago 32.

Westernite B iron: Copper-base, high-strength alloy iron for special service. Total C 3.30-3.40, Si 2.20-2.30, Mn 0.60-0.80, S 0.10 max, P 0.15-0.25, Cu 0.80-1.10, Cr 0.25-0.35. Ts, 30-35,000 psi; bhn (average), 207-229.

WESTFELT (Felt material) — Western Felt Works, Chicago.

Cut shapes according to user's specification for vibration dampening, deadening sound, insulating against heat and cold and filtering liquids, air and gases; also as oil or dust seals for bearings.

WESTSORB (Vibration absorbing felt for machine mountings)—Western Felt Works, Chicago.

WHITELIGHT (Magnesium and aluminum) — White Metal Rolling & Stamping Corp., Brooklyn, N. Y.

Magnesium sheets, plates, rods, bars, tubes, pipes, structural shapes, special extruded shapes, hollow extruded shapes and welding rods. Also aluminum, hollow extruded shapes, tubes and pipes.

WILCO (Contact and thermostatic metals)—H. A. Wilson Co., Newark 5, N. J.

Silver, tungsten, sintered powder metal, platinum, and alloys. Also thermostatic bimetal for all temperature ranges, deflection rates and electrical resistivities. Silver clad steel. Jacketed wire-silver on copper, invar, or other combinations requested.

WILMINGTON FIBRE (Fiber)—Wilmington Fibre Specialty Co., Wilmington 99, Del.

Cotton rag and paper, chemically treated, nonplastic material: Sheets, rods and tubes for machining or stamping into parts. Dielectric str, 200-400 (volts per mil inst); ts, 12-15,000 psi; resistant to shock and corrosion; high polish; in colors. For electrical and mechanical insulation.

WOLVERINE (Nonferrous tubing)—Wolverine Tube Div., Calumet & Hecla Consolidated Copper Co., Detroit 9.

Aluminum Brass: Cu 76, Zn 22, Al 2. Plain tubing and finned tube. Corrosion resistant; ts, 60-100,000 psi. For condenser, evaporator, heat-exchanger, and distiller tubes, and ferrules.

Phosphorized Admiralty Brass: Cu 71, Sn 1, P 0.02-0.10, Zn balance. Plain tubing and finned tube. Corrosion resistant; ts, 53-90,000 psi. For condenser, evaporator, heat-exchanger, and distiller tubes, and ferrules.

Arsenical Admiralty Brass: Same as Phosphorized Admiralty Brass except deoxidized with 0.02-0.10 arsenic.

Cartridge Brass: Cu 70, Zn 30. Tubing. Corrosion resistant; ts, 47-78,000 psi. For commercial tubing and plumbing tubing.

Red Brass: Cu 85, Zn 15. Plain tubing and finned tube. Corrosion resistant; ts, 40-70,000 psi. For condenser and heat-exchanger tubes, and plumbing pipe.

Low-Leaded Brass: Cu 67, Pb 0.6, Zn balance. Tubing. Corrosion resistant; ts, 48-85,000 psi. For plumbing pipe, pump lines, trap tubes and wherever some degree of machinability is required.

Copper, oxygen-free: Cu + Ag 99.90 min, (P 0.015-0.035, optional as deoxidizer). Plain tubing and finned tube. Corrosion resistant; ts, 32-55,000 psi; ductility, high. For gas lines, oil lines, plumbing pipe and tube, refrigerator lines, condenser, evaporator and heat-exchanger tubes.

Cupro-nickel, 30%: Cu 70, Ni, 30. Plain tubing and finned tube. Corrosion-resistant refractory alloy; ts, 55-85,000 psi. For condenser, evaporator and heat-exchanger tubes, distiller tubes, and ferrules.

Commercial Bronze: Cu 90, Zn 10. Tubing. Corrosion resistant; ts, 38-60,000 psi. For ornamental purposes.

High-Leaded Brass: Cu 67, Pb 1.6, Zn balance. Tubing. Corrosion resistant; ts, 52-75,000 psi; machinability, good. For general-purpose screw-machine products.

Muntz Metal: Cu 60, Zn 40. Tubing. Corrosion resistant. For condenser, evaporator and heat-exchanger tubes.

Aluminum 2S: Al 99.0. Plain tubing and finned tube. Very good formability and resistance to corrosion. For food and chemical handling and storage, heat exchanger tubes and oil burner tubing.

Aluminum 3S: Al 97, Mn 1.2. Plain tubing and finned tube. Ductility, good; ts, 16-29,000 psi; machinability, good. For heat-exchanger tubes and oil-burner tubing.

Cupro-Nickel 20%: Cu 80, Ni 20. Plain tubing and finned tube. Corrosion resistant; ts, 50-78,000 psi. For condenser, evaporator, heat-exchanger, and distiller tubes, and ferrules.

Cupro-Nickel, 10%: Cu 90, Ni 10. Plain tubing and finned tube. Corrosion resistant; ts, 44-73,000 psi. For condenser, evaporator, and heat-exchanger tubes, distiller tubes, and ferrules.

Nickel Aluminum Bronze: Cu 92, Ni 4, Al 4. Tubing. Highly resistant to corrosive action of saltwater, and to impingement; ts, 50-95,000 psi. For pipe, and condenser tubing.

Copper, arsenical: Cu + Ag 99.40 min, P 0.015-0.040, As 0.15-0.50. Corrosion resistant; ts, 32-55,000 psi. For condenser and heat-exchanger tubes.

Cupro-Nickel, 5%: Cu 95, Ni 5. Plain tubing and finned tube. Corrosion resistant; ts, 35-65,000 psi. For condenser, evaporator and heat-exchanger tubes.

WOODEX (Wood)—Wakefield Bearing Corp., Wakefield, Mass.

Impregnated rock maple parts which can be machined. Max cont serv temp, 100 F; inflammable; can be highly polished. For bearing surfaces in textile, road building, agricultural, tobacco and many other types of machinery.

WOODITE (Molded wood)—Syracuse Ornamental Co. Inc., Syracuse, N. Y.

Thermoplastic: Molded parts. Abrasion resistance, low; flexibility, low; opaque. For nameplates, decorative parts.

WORCESTER (Wire) — Worcester Wire Works, Division of National Standard Co., Worcester, Mass.

Steel wire in small diameter sizes, down to 0.002-in., low and high carbon content. Annealed, hard drawn, tempered, bright, lacquer finish, tinned, copper coated, cadmium coated and galvanized, stainless steel, aluminum, phosphor bronze, Monel, nickel silver, etc.

WORTHITE (Alloy Steel)—Worthington Pump & Machinery Corp., Harrison, N. J.

Ni 24, Cr 20, Mo 3, Si 3.5, C 0.07 max. Cu 1.75, Mn 0.6, Fe bal. Finished rods or bars and sand and centrifugal castings for turning, boring, welding, etc. Corrosion-resistant; high resistance to most acid slurries; ts (hot-rolled), 85,000; (sand cast), 70,000; ductility, medium; sp gr, 7.85; bhn (hot-rolled), 145-190; (sand cast), 140-175. For pumping equipment, valves, pipe fittings and special apparatus for corrosion resistance.

WYCKOFF (Cold finished steels)—Wyckoff Steel Co., Pittsburgh.

Controlled carbon and alloy steels: Turned, polished, ground and polished shafting. Annealed, strain and stress relieved; heat-treated, quenched and tempered steels; wide flats up to 12 x 2 in.

WYNENE (Plastics resin) — National Plastic Products Co., Odenton, Md.

Thermoplastic, nontoxic resin. When extruded offers lightness, flexibility, and resistance to moisture and chemicals. Neutral translucent and red, brown, tan, navy, royal blue, yellow, Kelly green, Nile green, black, and white. Suitable for electrical insulation and as protective coating for wires of all types.

XALOY (Iron-Nickel-Boron alloy) — Industrial Research Laboratory, Ltd., Los Angeles 11, Calif.

Sand castings, plate and rod. Requires no heat treatment. Ts, 43,100 psi; compr str, 225,000 psi; ys, 42,000 psi; Rock hdns, C62-C68; sp gr, 7.58; machinability, poor; weldability, good; abrasion resistance, high. For liners and plungers in oilwell pumps, liners and bushings for plastic and rubber extruders, drill guides, etc.

Xaloy-306: Ni, Co, Cr, Mo alloy cast to shape. Requires no heat treatment. Ts, 45,000 psi; compr str, 200,000 psi; ys, 44,000 psi; impact str, low; Rock hdns, C50; machinability, fair; resistant to hydrochloric acid; abrasion resistance, high. Lining or cylinders, applied by special process. For extruder cylinders for plastic extruding machines working with Saran and similar materials.

X-CREPE (Thermosetting plastics) — Cincinnati Industries, Inc., Cincinnati 15.

Phenol formaldehyde: Rolls, sheets, die cut and coiled; also preforms for compression molding and laminating. Abrasion resistance, medium, resists action of mild acid and alkaline solutions; flex str, 13,000-15,000 psi (ASTM D 650-42T); dielectric str, 300-400 (volts per mil inst); ts 9200-12,000; compr str, 23,000-38,000 psi; imp str (Izod), 1.0-4.5 ft-lb; black, brown and dark colors; sp gr, 1.45; opaque; machinability, fair. For structural or functional parts where properties of phenolics are desirable.

XLO (Music spring wire) — Johnson Steel & Wire Co., Worcester, Mass.

High carbon steel wire conforming to SAE 1090 and 1095. Properties, cold-worked: Ts, 250-450,000 psi; ys, 95% of ts; elong in 2 in., approximately 2%; machinability, poor; weldability, good; magnetic. For mechanical springs and wire forms.

X SUPERMAL (Pearlite malleable irons)—Jeffrey Mfg. Co., The, Columbus 16, O.

Properties, heat-treated: Ts, 60-70,000 psi; ys, 50-60,000 psi; elong in 2 in., 6-8%; bhn, 179-201; abrasion resistance, good. For chain links, sprockets, conveyor equipment, etc.

YOLOY (Nickel steel) — Youngstown Sheet & Tube Co., Youngstown, O.

C 0.05-0.40, Mn 0.3-1.0, Ni 0.75-0.375, Cu 0.40-1.75. Special service alloy steel in rough bars or billets, finished rods or bars, tubing, sheets, coiled strip, and plates, for hot forging, stamping, extruding and welding. Properties, untreated: Ts, 70,000 psi and up, depending on carbon and manganese content; ys, 50,000 psi min; impact resistance, high; weldability, excellent; machinability, good.

Z-70 (Powder metal)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

Contains 99% iron powder; pressed and sintered parts to specification; ts, as pressed and sintered, 70,000 psi; ys, as pressed and sintered, 63,000 psi; imp str (Izod), 3 ft-lb; Rock hdns, C55; abrasion resistance, high; self lubricating, has high resistance to wear. For ratchets, cams, valves, gears, etc.

Z-150 (Iron-copper powder metals)—Powdered Metal Products Corp. of America, Franklin Park, Ill.

Pressed and sintered parts of iron-copper powder metal to specification. At 7.8 density, ts, 120-150,000 psi; ys, 80,000 psi; Rock hdns, C40; abrasion resistance, high. For gears, cams, valves, etc.

ZeVeSeal (Sand castings)—Z-V Sales Co., Chicago 49.

Ferrous and nonferrous sand castings to specification.

ZILLOY (Rolled zinc alloy)—The New Jersey Zinc Co., New York.

Cu 1.00. Sheets and strip for forming and stamping.

ZIRCITE 1400 (Ceramic)—Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.

Rods and tubes. Abrasion resistance, high; chemical resistance, good; max cont serv temp, 2200 F; nonflammable; flexibility, high; dielectric str, 160 (volts per mil inst); ts, 9000 psi; compr str, 80,000 psi; flex str, 20,000 psi; moisture absorp, low; opaque; shatterproof; sp gr, 0.315. For use where high chemical, heat and impact resistance are required.

ZIRMET (Zirconium metal)—Foote Mineral Co., Inc., Philadelphia 44.

Ductile zirconium metal 99+. Rough bars or billets, finished rods or bars, wire and sheet. For machining, cold working, stamping, drawing and resistance welding. Properties, heat-treated: Ts, 40,000 psi; sp gr, 6.5; nonmagnetic; machinability, good. For acid-resistant or alkali-resistant parts, also vacuum tube elements.

Z-METAL (Spheroidized pearlitic malleable iron)—Z Metals, Inc., New York 17.

C 2.0-2.5, Mn 0.7-0.9, S 0.08, P 0.12-0.15, plus Mo, Cu in some. Sand castings. Can be hardened in salt bath, and can be flame hardened. Properties, heat-treated: Ts, 75,000-95,000 psi; ys, 50,000-60,000 psi; elong in 2 in., 8-18%; impact str (Izod), 8-10 ft-lb; bhn, 170-210; magnetic; weldability, poor; readily brazed; max cont serv temp, 1000 F; abrasion resistance, high; machinability, good. For cranks, levers, gears, power link chain, pump parts, etc.

Standard Stainless Steels

Standard AISI types listed numerically along with brief data on characteristics and representative machine applications. (Stainless steel tradenames, producers, and types and forms produced are listed on the following pages)

Type 301: Cr 18, Ni 8 (18-8 type) austenitic, hardenable by cold work only: Ts, 80-270,-000 psi; ys, 30-240,000 psi; elong in 2 in., 40-5%. Rods, bars, billets, wire, sheet, plate, strip and tubing. For parts requiring good corrosion resistance combined with high tensile strength and good ductility.

Type 302: Cr 18, Ni 8 (18-8 type) austenitic, hardenable by cold work only. Ts, 80-250,-000 psi; ys, 30-225,000 psi; elong in 2 in., 60-5%; fair machinability; excellent cold forming and welding properties. Sheet, strip, plate, bar, rod, forging billets and tube rounds, tubing, cold drawn shapes and structural shapes. For parts in acid handling, food and dairy equipment; shafting, bearing plates, heat-exchanger tubes, hydraulic tubing, piston rods, plungers, etc.

Type 303: Cr 18, Ni 8 (18-8 type) austenitic, hardenable by cold work only. Ts, 80-200,-000 psi; ys, 30-135,000 psi; elong in 2 in., 55-10%; good machinability; fair cold forming and welding properties. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes and structural shapes. For working parts in pumps and valves which must resist corrosion; for screw machine parts requiring strength plus good corrosion resistance.

Type 304: Cr 18, Ni 8 (18-8 type), austenitic, hardenable by cold work only. Ts, 85-250,-000 psi; ys, 30-225,000 psi; elong in 2 in., 60-5%; slightly better corrosion resistance than Type 302. Rods, bars, billets, wire, sheet, plate strip, tubing and castings. For parts in chemical equipment such as shafting, bearing plates, heat-exchanger tubes, etc.

Type 308: Cr 20, Ni 10 (20-10 type), austenitic, hardenable by cold work only. Ts, 80-200,000 psi; ys, 30-175,000 psi; elong in 2 in., 80-55%. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold drawn shapes, structural shapes and castings. For parts in chemical equipment; shafting, bearing plates, etc. Also welding rods.

Type 309: Cr 25, Ni 12 (25-12 type) austenitic, hardenable by cold work only. Ts, 95-190,-000 psi; ys, 45-165,000 psi; elong in 2 in., 50-5%; resists scaling to 2000 F, fair machinability, good cold forming properties and excellent weldability. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes and structural shapes. For parts that must operate continuously at high temperatures; oil burner parts, furnace parts, heat exchangers, air heaters, baffle plates, etc.

Type 310: Cr 25, Ni 20 (25-20 type), austenitic, hardenable by cold work only. Ts (annealed), 70-155,000 psi; ys, 30-140,000 psi; elong in 2 in., 55-5%; good weldability, drawing and stamping properties; fair machinability. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes and structural shapes. For parts subject to intermittent heating and cooling; oil burner parts, heat exchangers, dye house, paper mill and chemical plant equipment.

Type 316: Cr 18, Ni 12, Mo 3, (18-12-3 type) austenitic, hardenable by cold work only. Ts, 80-170,000 psi; ys, 35-150,000 psi; elong in 2 in., 55-5%; fair machinability, excellent welding and cold forming properties. Best creep strength at high temp and best corrosion resistance of all grades. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes and structural shapes. For parts requiring high corrosion resistance and high creep strength at elevated temperatures.

Type 317: Cr 18, Ni 12, Mo 4, (18-12-4 type) austenitic, hardenable by cold work only. Ts, 80-170,000 psi; ys, 35-150,000 psi; elong in 2 in., 60-40% (annealed). Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes, structural shapes, castings. For parts for equipment in paper industry; shafts, bearing plates, piston rods, etc.

Type 321: Cr 18, Ni 8, Ti 4 x C min; austenitic, hardenable by cold work only. Ts, 80-170,000 psi; ys, 30-145,000 psi; elong in 2 in., 55-5%; fair machinability, excellent welding and cold forming properties. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes and structural shapes. For welded parts not annealed after welding or which operate at 800-1200 F. Aircraft engine exhaust rings, flanges, etc.

Type 347: Cr 18, Ni 8, Cb 8 x C min; austenitic, hardenable by cold work only. Ts, 80-170,000 psi; ys, 30-150,000 psi; elong in 2 in., 50-5%; fair machinability, excellent welding and cold forming properties. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes and structural shapes. For welded parts not annealed after welding or which operate at 800-1200 F. Aircraft engine exhaust rings, flanges, etc.

Type 403: Cr 12 (straight chromium type) hardenable by heat treatment. Ts, 100,000; elong in 2 in., 30%; bhn, 202-241; high impact resistance and elastic limit. Bar stock and wire. For parts in turbine construction; steam turbine blades.

Type 405: Cr 12, Al 0.1-0.3 (12-Al type) not appreciably hardenable by heat treatment. Ts, 60-75,000 psi; ys, 35-50,000 psi; elong in 2 in., 40-20%; non-air-hardening. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes, structural shapes and castings. For parts requiring welding, annealing boxes, quenching racks, oxidation-resistant partitions.

Type 410: Cr 12 (straight chromium type), hardenable by heat treatment. Ts, 60-180,-000 psi; ys, 30-160,000 psi; elong in 2 in., 30-15%; good machinability and cold forming properties, good welding properties when annealed. Most popular forging grade of stainless. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes and structural shapes. Used where corrosion is not severe, for bolts, nuts, shafting, turbine blading, valve trim and heat-treated parts where hardness and toughness are desired.

Type 414: Cr 12, Ni 2, (12-2 type), hardenable by heat treatment; magnetic. Ts, 119-000 psi (approx); ys, 94,000 psi (approx); elong in 2 in., 25% (approx); good corrosion resistance. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes and structural shapes. Knife blades, tempered rules, straight edges, scraper knives, mild springs, etc. Parts requiring better corrosion resistance and higher strength than Type 410.

Type 416: Cr 12, (straight chromium type with sulphur or selenium added). Ts, 70-170,000 psi; ys, 40-140,000 psi; elong in 2 in., 30-10%; excellent machinability; fair cold forming properties, fair corrosion resistance. Bar, rod, forging billets, wire, cold-drawn shapes. For mass-produced machined parts. Carburetor, instrument and electrical parts; excellent for screw machine parts.

Type 420 and 420F: Cr 13, C 0.35 (straight chromium type) highly hardenable by heat treatment. Ts, 95-250,000 psi; ys, 60-200,-000 psi; elong in 2 in., 30-5%; fair machinability and cold forming properties; good corrosion resistance. Type 420 F is free machining. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes and structural shapes. Generally used for hard, keen, knife edges for cutlery and surgical instruments.

Type 430: Cr 17 (straight chromium type), nonhardenable by heat treatment; resists scaling to 1500 F; excellent cold heading properties, excellent machinability, does not discolor in atmosphere. Ts, 60-85,000 psi; ys, 35-55,000 psi; elong in 2 in., 35-20%. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes and structural shapes. For press plates, oil burner parts, screw machine parts, trim for automobiles such as body moldings, hub caps, finishing washers, gas tank caps, etc.; also trim for appliances.

Type 430F: Cr 17 with 0.07 S or Se; (straight chromium free machining type), nonhardenable by heat treatment. Ts, 60-85,000 psi; ys, 35-55,000 psi; elong in 2 in., 25-10%; excellent machinability, fair cold forming properties. Forging billets, hot-rolled and cold-finished bars, wire and polished shafting. Particularly suitable for parts requiring considerable machining and which need only moderate corrosion resistance; screw machine parts.

Type 431: Cr 16; Ni 2; (straight chromium type), hardenable by heat treatment. Ts, 110-200,000 psi; ys, 80-150,000 psi; elong in 2 in., 20-15%; good machinability; fair cold forming properties; resists scaling to 1500 F. Best corrosion resistance of all hardenable stainless steels. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes, structural shapes. For parts requiring excellent physical properties coupled with high corrosion resistance.

Type 440 C and 440 A, B and F: Cr 17; C 1.00 (straight chromium type), hardenable by heat treatment. Ts, 110-285,000 psi; ys, 60-275,000 psi; elong in 2 in., 15-2%; fair machinability and cold forming properties. Types A and B are of same analysis except for lower carbon content, thus are less hardenable. Type F is free machining. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes, structural shapes. For needle valves, ball check valves, ball bearings, scissors, rules, cutlery, etc.

Type 442: Cr 20, Cu 1; hardenable by cold work only; magnetic. Annealed, approx properties are: Ts, 90,000 psi; ys, 50,000 psi; elong in 2 in., 22%. Resists scaling to 1600 F. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes, and structural shapes. For scale-resistant parts such as in furnaces, soot blower tubes, stirring rods and ladles for molten nonferrous metals.

Type 446: Cr 27 (straight chromium type), nonhardenable by heat treatment. Ts, 75-85,000 psi; ys, 45-60,000 psi; elong in 2 in., 35-20%; resists scaling to 2000 F; corrosion resistance equal to 18-8. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes, structural shapes. For parts requiring moderate strength when operating at high temperatures; valves and fittings, baffle plates, heaters, oil burner parts, etc.

Types 501 and 502: Cr 4-6, Type 501 has over 0.10 C; Type 502 has 0.10 C max; otherwise analyses identical. Hardenable by heat treatment; magnetic. Ts, 60,000 psi min; ys, 25,000 psi min; elong in 2 in., 30% min. Heat and corrosion resistance between that of plain steels and the high chromium and chromium-nickel steels. Sheet, strip, plate, bar, rod, forging billets, tube rounds, tubing, cold-drawn shapes, structural shapes. For parts in high temp service; oil refinery and chemical equipment.

Stainless Steel Tradenames

Tradenames of stainless steels listed alphabetically along with the names of the producing companies and the standard AISI types and forms produced. (For data on analysis, characteristics and representative applications, see Page 311)

ALLEGHENY METALS — Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Types 301, 302, 303A, 303C, 303S, 304, 305, 308, 309, 310, 314, 316, 317, 321, 347, 403, 405, 410, 414, 416, 418, 420, 430, 431, 440A, 440C, 446, 501, 501 plus Mo, 502, 502 plus Mo. All types in bar, sheet, strip, plate, shapes, forgings, castings, and wire.

ALMET—Alloy Metal Wire Co. Inc., Prospect Park, Pa.
Types 302, 304 and 420 in wire, rod and strip.
Types 303, 308, 309, 310, 316, 317, 321, 347, 410, 416, 430, 442, and 446 in wire and rod.

ARMCO—Armco Steel Corp., Middletown, O.
Types 302, 304, 304ELC, 308, 316, 316ELC, 317, 317ELC, 321, 347, 410, and 430 in bar, wire, sheet, strip, plate, and angles.
Type 301 in bar, wire, sheet, strip, and angles.
Types 309, 310 and 446 in bar, wire, sheet, strip, and plate.
Types 405, 414, 420, 431, and 442 in bar, wire and angles.
Types 303, 416, 420F, 430F, 440A, 440B, 440C, 440F, 501 and 502 in bar and wire.
Type 403 in bar.

B & W CROLOY—Babcock & Wilcox Tube Co., Beaver Falls, Pa.
Types 302, 302B, 304, 308, 309, 309Cb, 310, 316, 316Cb, 317, 321, 347, 405, 410, 414, 420, 430, 446, 501, 501 with Mo, 502, and 502 with Mo.

CARPENTER—The Carpenter Steel Co., Reading, Pa.
Types 301, 302, 302B, 303, 304, 305, 308, 309, 310, 314, 316, 317, 321, 329, 347, 403, 405, 406, 410, 414, 416, 420, 420F, 430. 430F, 431, 440A, 440B, 440C, 440F, 443 No. 10, No. 20, and 446 in bars, billets, wire and strip.

CRUCIBLE STAINLESS—Crucible Steel Co. of America, New York.
Types 301, 302, 302B, 303, 303A, 304, 305, 308, 309, 310, 311, 312, 314, 316, 317, 318, 321, 325, 329, 330, 347, 347F, 403, 405, 406, 410, 414, 416, 418, 420, 420F, 430, 430F, 431, 440A, 440B, 440BM, 440BMF, 440C, 440F, 442, 446, 501, 501 Mo, 502 and 502 Mo in ingots, billets, bars, forgings, plate, sheet, hot and cold-rolled strip, angles, tubing, rods, wire, or castings.

ENDURO—Alloy Steel Div., Republic Steel Corp., Massillon, O.
Types 301, 302, 302B, 303, 304, 305, 308, 309, 309S, 310, 316, 317, 321, 347, 403, 410, 414, 416, 420, 420F, 430, 430F, 431, 440RA,B,C and F, 442, 446, 501, and 502 in pig or ingot, rough bars or billets, finished rods and bars, coil and straight strip, tubing, wire, sheet, and plate.

ES—Eastern Stainless Steel Corp., Baltimore 3, Md.
Types 301, 302, 302B, 304, 305, 309, 316, 321, and 347 in sheet and plate.

GLOBE—Globe Steel Tubes Co., Milwaukee.
Types 304, 316, 321, 347, 410, 430, 446, 501, and 502 in seamless tubing.

GLOWELD—Globe Steel Tubes Co., Milwaukee.
Types 301, 302, 304, 308, 309, 310, 316, 317, 321, 347, 403, 405, 410, 430, and 446 in welding tube.

INGERSOLL—Ingersoll Steel & Disc Div., Borg-Warner Corp., Chicago.
Types 302, 304, 316, 317, 347, and 430 in sheet and plate, and in 18-8 stainless-clad sheet and plate from No. 18 gage to ¼-in.
Types 309, 310, 410, 446, 501, and 502 in sheet and plate.

JESSOP—Jessop Steel Co., Washington, Pa.
Types 301, 302, 303, 304, 308, 310, 316, 317, 321, 347, 403, 405, 410, 416, 420, 420F, 440A, 440B, 440C, 440F, 430, 430F, 442, 446, 501, and 502.

MISCO METAL—Michigan Steel Casting Co., Detroit 7, Mich.
Types 309, 310, 330, and 430.

SHARON—Sharon Steel Corp., Sharon, Pa.
Types 301, 302, 302B, 303, 304, 308, 309, 310, 316, 317, 321, 347, 403, 405, 406, 410, 414, 416, 420, 420F, 431, 440A, 440B, 440C, 440F, 430, 430F, 442, 443, 446, 501, and 502.

STERLING — Firth Sterling Steel & Carbide Corp., McKeesport, Pa.
Types 301, 302, 303, 304, 308, 309, 310, 316, 317, 321, 347, 403, 405, 410, 414, 416, 420, 420F, 430, 430F, 431, 440A, 440B, 440C, 440F, 442, and 446 in billets, bar, forgings, hot-rolled coil, cold-drawn rod, centerless-ground bar, and cold-drawn wire.
Types 304, 310, 316, 317, 321, 347, and 410 also in tube rounds.

STERMET—Sterling Alloys Inc., Woburn, Mass.
Types 302, 303, 309, 310, 312, 316, 327, 330, and 347.

SUPERIOR—Superior Steel Corp., Carnegie, Pa.
Types 301, 302, 304, 305, 310, 316, 321, 347, 410, 414, 420, 430, 440A, 440B, 440C, and 446 in hot and cold-rolled strip.

TIMKEN—Timken Steel & Tube Div., Timken Roller Bearing Co., Canton 6, O.
Types 301, 302, 302B, 303, 304, 308, 309, 310, 316, 321, 347, 403 410, 416, 420, 440A, 440B, 440C, 430, 430F, 442, 501, 502 and 16-13-3.

U·S·S STAINLESS—American Steel & Wire Co., Cleveland, O.
Types 301, 302, 302B, 303, 304, 308, 309, 309S, 309Scb, 310, 314, 316, 317, 318, 321, 347, 403, 405, 410, 416, 420, 430, 446, 501, and 502.

Materials by Type

Cross-reference index providing a key between alloying constituents and tradenames. Tradenamed materials are indexed primarily under the base or predominant alloying element or, in some cases such as bearing metals, under the primary use. Alloying elements which control the properties of the material are arranged alphabetically as subheads under the main heads. In a few cases additional controlling elements are added in italics. (For data on characteristics and applications, see Page 252.)

ADHESIVES & CEMENTS

Amberlite
Armstrong's
Hydrocal
Hydrostone
Inceloid
Koppers
Magic Iron Cement
Paisley
Penacolite
Pleximent
Reanite
Resin X-2
Rez-N-Glue
Tego

ALUMINUM BASE

Alclad
Alcoa
Allcast No. 60
Apex
Bohnalite
Cemco
Doler Alsiloy #1, 9, 10
Do-Lite
General
Hills McCanna
Hytenat
Jobbins
Kaiser Aluminum
Lectro-Pat
Minimesh
Nemaloy
Permite
Permoid
Precision
Red X
Reynolds
Rigidized Metal
Ternalloy
Trualoy
United Wire
Utica
Welbronco
Wellcast
Whitelight
Wolverine

ASBESTOS

Aztec
J.M. Asbestos Ebony
J.M. Transell
J.M. Transite
J.M. Quinorgo
J.M. Quinterra
Stonewall
Victopac
Victor

BEARING METALS

Babbitts

Acorn
Adamant
  Super Genuine
American Marine
  Genuine
Bearite
Cadnickel
Defender
Delta
Dutch Boy
D-Z-L Genuine
Glacier
Glyco
Grac
Grapho
Hoyt
Lime
Magnolia
  Antifriction Metal
Mogul
National
Pitt
Power Nickel-Genuine
Pyramid
Stonewall
United American
Bound Brook
Bunting
Compo
Durex
Elephant Brand
Federal
Formetal
G Alloy
Gramix
Graphalloy
Idealoy
Johnson
Ledaloyl
Lithlead
Lubrik
Lumen Alloys
Magnolia No. 120
Magnolia AA
Magnolia Isotropic
Metaline
Monarch
Mueller 600
Nicuite
Olds Bearing Bronze
Oldsmoloy
Powdiron
Promet
Sabeco
Sandusky
Satco
Selflube
Sumet
Velox

Other Bearing Metals

Agricola
Anfriloy
Asarcoloy No. 2
Bearium Metal

BIMETALS

Chace
Truflex
Velvetouch
Wilco

BISMUTH BASE

Cerrobase
Cerrobend
Cerrolow 117
Cerromatrix
Cerrosafe
Cerrotru

BONDED OR PLATED

Alcuplate
Al-Fin
Allegheny Metal, Stainless Clad
American
Apollo
Armco
Bethanized
Beth-Co-Lite
Bethelductor
Brassoid
Bundyflex
Chromaloid
Colorstrip
Copperweld
Galvannealed
Ingaclad
Lektromesh
Makepeace
Nickeloid
Ni Clad
Ornametle
Permaclad
Platinum Clad
Plymetl
Rosslyn Metal
Silvercote
Superior
Suveneer
Thomastrip
U.S.S.
Weiralead
Weirzin

CARBON & GRAPHITE

Graphalloy
Graphitar
International
Karbate
Key
Morganite
National
Ohio
Purebon
S. C. P.
Speer
St. Marys
Supergraph

CERAMICS

AlSiMag
Ceraware
Colonial
Cordierite
Crolite
Elemite
Isolantite
Lavite
Lavolain
Louthan
Pinco
Poro-Stone
Steatite
Stupakoff
Stupalith
Thermolain
Titanates
Universal
Usalite 1350
U. S. Standard
Vitric-10
Zircite 1400

COBALT BASE

Alnico (Al, Ni)
Austenal
Cunico
Elgiloy
Haynes Stellite
Redhard NF
Rexalloy
Tantung (Cr, W)
Vanadium Permendur
Vectolite

COMPOSITIONS

Abso-Lute
Aertite
Armatite
Armstrong's
Celite
Cel-O-Glass
Cohrlastic
Darex
Dodge
Dufelt
Eel-Slip
Elastro-Rib
Empire
Fabreeka
Fairprene
Featherweight
Felpro
FV
Gaskofelt
Harris Silentbloc
Hy-Temp
Insulkote
Irvington
Irv-O-Slot
Irv-O-Volt
Key-Tite
Korfund
Lord
Magic Glaze & Spot Putty
Magic Plastic Lead
Multi-Weave
National Switch Insulation
Nylontron G
Razoseal
Refrasil
Resistofelt
RS
Ruberoid
Santocel
Silentbloc
Spaulding T Board
Ty-Loy
Unisorb
Velbuna
Vellumoid
Vellutex
Vimlite
Vistex
Vulcoid

COPPER BASE

High Copper

Ampco Metal
Bridgeport
Chase Tellurium Copper
Cramp's Superstrength Bronze
Cupaloy
D-H-S
Eclipse
Elkonite
Federal
General Plate (Mn, Ni)
Hussey
HyTensl
Kensico
Laminum
LMC
Mallory
Precision
Revere
Rigidized Metal
Shenango Penn
Superior
Tru-Con
Welbronco

Copper-Aluminum

Ambraloy
Ampcoloy
Ampco Metal
Aur-O-Met
Avialite
Everdur (Si)
Frontier
Molin Metal
Resistaloy (Ni)
Revere (Si)
Tempaloy (Ni)
Trualoy

Copper-Aluminum-Iron

Ampcoloy
Resistac
Tuf-Stuff 224E

Copper-Beryllium

Berylco
Conduloy
Viculoy
Weldrawn

Copper-Lead

Bridgeport Ledrite
Lithlead

Copper-Lead-Zinc

Bridgeport
Chase
Easy Ream
Scovill
Sumet
Tiger

Copper-Nickel

Advance
Ambrac
Ampco Metal
Anaconda
Anaconda Cupro-Nickel 754
Bridgeport
Cunife (Fe)
Cupron
Dairywhite
Excelsior
Frontier
LMC
ZeVeSeal
Manganin (Mm)
Olds Bearing Bronze (Pb)
Oldsmoloy (Cr, Mo)
Phosnic
Revere
Telnic Bronze
Ti-Nic-O-Sil
Waukesha Metals
Wolverine

Copper-Silicon

Bridgeport
Duronze Alloys
Everdur (Mn)
Herculoy
Copper-Tin
Ampco Metal
Bridgeport
Frontier
Harris 80 10 10
Lubrik (Pb, Zn)
Machinery Bronze (Pb, Zn)
Scovill
Seymour
Trualoy (Pb)
Velox (Pb)

Copper-Tin-Zinc

Anaconda
Bridgeport
Chamet
Non-Gran
Scovill
Trembronze

Copper-Zinc

Ampco Metal
Anaconda
Bridgeport
Bridgeport Ledrite
Elephant Brand (Ni)
Hecla (Pb, Sn)
Logan (Pb)
Nittany (Pb)
Revere (Ni)
Scovill
Seymour (Ni)
Seymour (Pb)
Titan (Sn)
Tobin (Sn)
Tombasil (Si)
Trualoy (Fe, Al)
Wolverine (Al)

Other Copper Alloys

Alpro
Ampcoloy
Buffalo
Doler Brass
Elephant Brand
LMC
Moccasin
Monarch
Precision
Randall
Revere
Riverside
Sandusky
Scovill
Shenango-Penn
Tru-Con

United Wire
Welbronco
Weilcast
Western
Wolverine
ZeValScal

FELTS

American
Booth
Co-Ro-Felt
Draper
Feltan
Felters
"K" Felt
Westfelt
Westsorb

FIBERS

Brandywine
Centraline
Diamond
Fabroil
Franklin
Fyberoid
Maizewood
National Fibre
Peerless
Penn
Spaulding Armite
Spaulding Fibre
Spauldo
Victorite
Wilmington Fibre

GLASSES

Aerolite
Blue Ridge
Carrara
Corning
Dunbar
Duolite
Duplate
Electrapane
Fiberglas
Flexseal
Herculite
Hi-Test
KGI
LOF
Mirropane
Multiplate
PC
Pennvernon
Pittsburgh
Polaroid
Pyrex
Safetee
Solex
Thermopane
Tuf-Flex
Twindow
Vycor

IRONS

Armco
Byers Genuine
Crasfloy
Cromonite
Durichlor
Duriron
Electromet
Ermalite
Falls
Frankite
Globeiron
Hiperco
Hipersil
Hytemco
Jewell Alloys
Kovar
Meehanite Metal
Multimet Alloys
Shenango-Penn
Silvery Mayari
Toncan
X Supermal
Z-Metal

Malleable Irons

Belectromal
Belmalloy
Duramal
Ermal Z-Metal
Gunite
H.T.M.
Jefaloy A Series
Jeffrey 55M
Mallix
Perduro
Promal
Shockproof
Supermal
Super Y

Alloy Cast Irons

Acipco
Adamite
Afcoloy
Afcomet
Afiron
Belectric
Binneymetals
Buflokast
Carcoloy
Centralloy
Chemalloy N Series
Diamite
Eastern
Elverite
Gunite
Hitest
Hunt-Spiller
Iralite
Kelcast
Kelcast (Mm)
K Spun
Littite
Ni Hard
Ni-Resist
Ni-Tennsyliron
Silmanal
Sorbo-Mat
Strenes C
Tam
Tisco No. 150
Trenite
Tuftest
Westernite

LEATHERS

Graton & Knight Leathers
Korry-Krome
Sirvis
Vim

MAGNESIUM BASE

Apex
Doler-Mag
Dowmetal
Flylite
Hills McCanna
M-13
Mazlo
Superior
Utica
Welbronco
Wellcast
Whitelight

MICA

Micabond
Micanite
Mycalex

MOLYBDENUM BASE

Cleve-Tung
Fansteel

NICKEL BASE

Agaloy
Alray
Bundyweld
Chlorimet
Coast Metals
Conpernik
Cooper Alloys
Eastern
Hastelloy
Hipernik
Hipernik V
Illium G
Inconel
Inconel X
K-42-B
Karma
Minimesh
Molybdenum Permalloy
Monel
Nickel
Ni-Hard
Ni-Span
Ni-Span C
Precision
Refractaloy
Sandusky
Shenango-Penn
Tophet
United Wire
Weldrawn
Xaloy (Fe, B)

PLASTICS—THERMOPLASTIC

Cellulose Acetate

Chemaco
Durashield
Fibestos
Hercules
Inceloid
Koppers Cellulose Acetate
Lumapane
Lumarith
Netco
Nixon C/A
Nixon C/A/B
Plastacele
Plax
T1
Tenite
Tru-Size
Tulox

Cellulose Acetate Butyrate

Plax
T2
Tenite
Tru-Size

Cellulose Nitrate

Nitron
Nixon C/N
Pyralin

Cellulose Propionate

Forticel

Ethyl Cellulose

Chemaco
E. C.
Ethocel
Hercules
Koppers Ethyl Cellulose
Nixon E/C
Norcell
Plax
Tru-Size
Tulox

Methyl Methacrylate

Gemlite
Irilite
Lucite
M. M.
Plax
Plexiglas
Tru-Size

Polyamide

Nylon
Polyco

Polyethylene

Bakelite
Carlon
Jodapac
Netco
P. E.
Plax
Polythene
Rextrude
Turbo
Visqueen

Polyisobutylene

Vistanex

Polystyrene

Bakelite
Chemaco
Koppers

Polystyrene

Lustrex—LX
M. P.
P
Parsan
Piccolastic
Plax
Polyflex
Styron
Tru-Size

Polythene

Jodapac

Polyvinyl Chloride

Fibron
Netco
Saran
Transflex
Voltron

Styrene

Luxtrex-L
Marbon "S"
S. Polymer

Vinyl

Ace Saran
Bakelite
Butacite
Clearseal
Elasti-Glass
Elastron
Elvacet
Elvanol
Gemflex
Geon
Irilite
Lumite
Pliovic A and AO
Resproid
Saflex

Vinyl Chloride Acetate

Syntholvar
Texrub
Tru-Size
Turbo
Vinylite

Others

Ameroid
Cerex
Cibanite
Cliderite
Compar
Densewood
Dow Corning
Duralon
Genloid
Hyflex
Irv-O-Lite, XTE 30
Ivi-Flex
Joda
K
Kel F
Molex
Parian
Parnal
Plastikflex
Plio-Tuf
Resilon
Royalite
Sealon
Tego
Tri-Mensional Process
Turbo
Tygoflex 40
Tygon
Ultron
Wynene

PLASTICS—THERMOSETTING

Allyl

Allymer

Cold Molded

Garit
Gummon
Hemit
Tegit
Thermoplax

Furane

Haveg 41, 48, 60
Permanite

Melamine Formaldehyde

Calcerite
Consoweld
Farlite
Formica
Insurok
Melmac
Micarta
Nevamar
Panelyte
Phenopreg
Plaskon
Plaskon Alkyd
Resimene
Taylor Fibre

Phenolic

Bakelite
Baker Casting Resin
Catabond
Celoron
Consoweld
Dilecto
Durez
Durite
Farlite
Fiber Plast
Formica
G E
Haveg 41, 48, 60
Heresite
Indur
Indur Varnish
Insurok
Intuc
Kys-Ite
Lamitex
Marbletta
Mecoboard
Micarta
Neillite
Nevamar
Ohmoid
Panelyte
Phenopreg
Plastone
Plyophen
Resinox
Ryertex
Sko-Resin
Spauldite
Synthane
Taylor Fibre
Taylor Phenol Fibre
Textolite
X-Crepe

Polyester

Glastic
Laminac
Marcoboard
MR
Vibrin

Styrene-Alkyd

Photoelastic Fosterite
Tetrafluoroethylene
Teflon

Urea Formaldehyde

Beetle
Insurok
Plaskon
Uformite
Vinyl
Clearseal
Texrub

Others

Baker Impregnating Resins
Cardolite
Cellulak
CR-39
Dow Corning DC 993 & 996
Enrup
Furatone
Gemloid
Good-Rite Resin 50
Hi-Den
Homalite
Hysol 6000
Kralastic
Insurok
Lamicoid
Lether-Tech
Nixon-V/L
Paraplex
Phenolite
Resistoflex
R. K.
Rosite
Selectron
Surco American
Valite
Victoprene

PLATINUM BASE

Baker
Elkonium
Ney-Oro-G
Paliney (Pd)
Wilco

POWDER METALS

Autolube
B-50
Camet
Carboloy
Croloy
Crowley
Durex
E 1 to E 15
E 70
F 10 to F 80
Ferramig G
Gempco
Gibsiloy
Gramix
Hardy
Hardyne
Hevimet
Kennametal
Keystone
Ledaloyl
Magicores
MD
Moraine
MRCO
National
New Jersey Zinc
Oilite
Permium
Plast-Corron
Plast-Iron
Plast-Manganese
Plast-Nickel
Plast-Silicon
Plast Sponge
Plast-Steel
Powdiron
Puremet
Radio Cores
Sinteel
Stackpole
St. Marys
Vasco
Velvetouch
VR
W-30
W-55 a
W-56
W-58
W-100
Wel-Met
Wilco
Z-70
Z-150

REFRACTORIES

Blazecrete
B & W
Firecrete
Hemit
Shamva Mullite

RUBBERS

Acadia
Ace
Acushnet
Ajax
Butaprene
Cell-Tite
Chemigum
Continental
Cush-N-Fit
G E
General
Grakone
Herecrol RC
Hycar
Johnson
Luzerne
Neoprene
Orco
Paracril
Rub-Erok
Silastic
Sirvene
Spongex
Tensilastic
Texfoam
Thiokol
Tyer
U. S. Rubber
Victolene
Vix-Syn

SILVER BASE

Elkonite
Elkonium
Silmanal (Mn, Al)
Stackpole (W)
Stackpole (Mo)
United Wire
Wilco

STEELS

Carbon Steels

Agaloy
Ajax
Athenia
Bethlehem
Bethloc
Birdsboro
Blue Anchor

Bundyweld
Calstrip
Casteel
Circle L
Continental
Cumberland
Cuyo
Dodge
Economo 17
Elastuf
Electrunite
Esco
Farrell's
Follansbee
Globe
Granada
Ideal Electric Steel
Inland
Jalcase
Laminum
Lukens
Michigan
Midvale
Miline Hollow Die Steel
Minimesh
Nikoh
Page
Pittsburgh
Pompton
PSF
Red Anchor
Rockrite
Ryerson
S-G
Sharon
Sivyer
Standard
Strain-Tempered
Summerill
Superior
Thinsteel
Timken
Ultra-Cut
U. S. S. Amercut
U. S. S. American Quality
U. S. S. Shelby
Wyckoff
Xlo

Chromium Steels

Agaloy
American
Armacast
Bethlehem
B & W Croloy
Carpenter
Chrome-Vanadium
Circle L
Duraloy
Els 45
Elastuf (v)
Hotform
Kinite
Kleenkut
Lukens
Midvaloy Hi-C Hi-Cr
Miline Hollow Die Steel
Par-Exc (W)
Peterson
Shell Die (Si, Mo)
Superior No. 3
Teton
Thermalloy HC 250

Chromium-Manganese Steels

Bethlehem
Lukens
Nurex
PSI

Chromium-Molybdenum Steels

Amsco
Atlas No. 93
Bescoloy
Bethlehem
B & W Croloy
Calumetal
Congo (W, Co, V)
Continental
DM
DM 45 (Si, Mn)
Dodge
Elastuf
Fahrite
Lukens
Pressuredie
Sicromo (Si)
Sivyer
Summerill
Superior
Tisco (Mn)
Utaloy

Chromium-Molybdenum-Nickel Steels

Bethlehem
Calite
Continental
Cuprodie
Durite
Durodi
Els 57
Elastuf
Finkl
Hascoloy
Heppenstall
Hy-Ten
Isocast
Lukens
Nikrome "M"
Sivyer
Tisco
Worthite (Si)

Chromium-Nickel Steels

Agaloy
American
Armco
Bethlehem
B & W Croloy
Calite
Calumetal
Carpenter
Cimet
Continental
Duraloy
Durco
Evansteel
Isocast
Lukens
Par
Thermalloy
U. S. S. Corten

Chromium-Vanadium-Tungsten Steels

Bethlehem
Gold Anchor
Lukens
Novo Superior

Copper Steels

Beth-Cu-Loy
Bethlehem
Continental
Dull-Coat
Konik
Lukens
U-Loy

Manganese Steels

Amsco
Calumetal
Chromanal
Esco
Kaisaloy
La Sulphite 8640
Lukens
MM
Moly-Telastic
Naco
Neloy
Nicloy-Moly
Ross-Meehan
Silver Star
Stressproof
Strong #18
Tisco
Tritex No. 2
Tufaloy
Univan "C"
U. S. S. Ar Steel
U. S. S. Man-Ten
U. S. S. MX

Manganese-Molybdenum Steels

Bethlehem
Calumetal
Continental
Dodge Farrell's
Hy-Ten
Hy-Ten (Cr)
Lukens
MacHempite
Pitaloy
Ross-Meehan
Sivyer
Tufaloy

Manganese-Nickel Steels

Allegheny Ludlum
Bethlehem
Graph M.N.S.
Hy-Tuf
Lukens
Manganal
Resistress (V)
Tisco
Univan
U. S. S. Mang Ni-Cu

Manganese-Silicon Steels

Bethlehem
Carcometal (Cu)
Carpenter
Hy-Tuf
Isocast
Lukens

Molybdenum Steels

Bethlehem
Braemow M-2
Lukens
MCA
Red Streak
Republic Aldecor (Cu, Si)
Sivyer

Molybdenum-Nickel Steels

Bethlehem
Continental
Finkl
Lukens
Monimax
Republic Double-Strength (Cu)
Republic NES 70
Tigerloy

Nickel Steels

Allegheny Ludlum
American
Bethlehem
Carpenter
Chromel
Circle L
Dodge
Lukens
Nicloy
Nilvar
Yoloy

Nickel-Chromium Steels

ABK Metal
American
Bescoloy
Chromax
Chromel
Discoloy 24
Fahralloy
Michiana
Mumetal (Cu)
NA NA-1 NA-2
Nichrome Nichrome V
Nikro M
Pioneer
Pyrasteel
Standard Alloy H-R
Thermalloy
Tioga

Silicon Steels

Allegheny Grade 609, (M)
Armco
Bethlehem
Graph-Mo
Lukens
Mosil
Silman
Silmo
T-Loys (Mo)

Special Steels (Not otherwise specified)

Acme Strip
Ammonoduct
Anchor Carbon-Vanadium
Austenal
Binney
Birdsboro
Buffalo
B & W 5202
Deltamax
Jalloy
Konik
Kromal
Lukens
Malga Elektro Special
Malgaloy
Malga M.R. O. Special
Malga Nontempering Special
N-A-X
Nitralloy
Otiscoloy
Red Circle
Sealmet
T.R.S.-R.M.
U. S. S. Premier

Other Alloy Steels

Acipco
Adamite
Aldecor
Amera-Mag
American
Aristoloy
"AW" Dynalloy
Bendix
Bethco
Beth-Co-Weld
Coast Metals
Colonial
Columbia
Commercial
Commonwealth
Cuyo
Deward
Duc-Ten
Dynalloy
Electrunite
E-Z Cut
Globe
Granada
Graph-Al
Graph-Tung
Gunite
Ideal Electric Steel
Intra
Isocast
J & L Steels
Kidd
Marvel
Mayari R
Michigan
Midvale
National
National-Standard
Ohmaloy
Ostuco
Pittsburgh
PSF
Purple Strand
Python
Rayduct
Red Cut Superior
Republic Cor-Ten
Rigidized Metal
Ross-Meehan
Ruralductor
Ry-Ax
RyCase
Rychrome
Rycut
Ryersor
Ryex
Rytense AA
Seminole Hard
Sharon
Sicromo
Smavroc
Standard
Tam
Tesco
Thinsteel
Timken
Ti-Namel
T Loys
Trantinyl
U. S. S. Amercut
U. S. S. American Quality
U. S. S. Carilloy
U. S. S. Shelby
Westernite
Worcester
Wyckoff
ZeVeSeal

Stainless Steels

Acoloy
Allegheny Metals
Almet
Armco
Austenal
Bethadur
Bethalon
Carpenter
Chemalloy
Circle L
Cooper Alloys
Crucible
Durimet 20
Electronite
Enduro
ES
Esco
Fort Pitt
Globe
Gloweld
Hi-Steel
Ingaclad
Ingersoll
Jessop
Micro-Rold
Midvale
Minimesh
Misco Metal
Rigidized Metal
Rockrite
Ryerson
Sharon
Standard
Sterling
Superior
Thinsteel
Timken
Trentweld
U. S. S. Shelby
U. S. S. Stainless
Weldrawn

TANTALUM BASE

Fansteel

TUNGSTEN BASE

Cleve-Tungsten
Diecarb
Fansteel
Firthaloy
Firthite
Haystellite
Kennametal
Mallory
Talide
Tungsite
V R
Wilco

VARNISHES

Harvel
Irvington
Sterling

WELDING AND HARDFACING ELECTRODES, BRAZING COMPOUNDS AND SOLDERS

Abrasoweld
Aerisweld
Agile
Airco
Aircolite R
Aircoloy R
Aladdin Rod
All-State
Alternex
Aluminweld
Ampco-Trode
Amsco
APW
Arcaloy
Arc-Craft
Arcos
Beryl-Trode
Borod
Bridgeport
Bronze-Arc
Bronzochrom
Carbon-Moly .50
Cerroseal
Chrome-Boride
Chromeface
Chromend
Chromolloy
Cletaloy
Coast Metals
Colmonoy
Colomonoy Nicrobraz
Crescent
Cromansil
Cuttrode
Dieweld
Drawalloy
Dustcote
Easy-Flo
Economy Hardface
Elkaloy A
Ensign
Ensign 64
Eureka
Eutechrom
Eutecrod
Eutec Strainrod
Eutec Strainrode
Eutectic
Eutectofilm
Eutectrode
Faceweld
Farmface
Ferroweld
Fleetweld
Fluxine
Frogalloy
Fusion
Genex
Han-Omatic
Handy Flux
Harchrome
Harcote
Hardalloy
Hardex
Hardweld
Harmonang
Harnimang
Harstain
Hartop
Hartung
Hascrome
Haynes
Haynes Stellite
Haystellite
Herculoy
Indium
Kop R Arc
Kwikmetal
Lenk Super Aluminum Solder
Litecote
Magic Plastic Body Solder
Manganweld
Marquette
Maurath
McKay
Meco
Metal & Thermit
Metco-weld H
Molex
Mo-Mang
M & T
Nickalloy
Nickel Arc
Nicromel
Ni Hard
Ni Rod
Ni Rod 55
Nubraze
Orrweld
Oxweld
Oxycuttend
Pal Weld
Penn
Phosco
Phos-Copper
Phos-Trode
Pluralloy
Raco
Racolloy
Railface
Ranite
Resistwear
Rex-A-Lite
Rextung
Rexweld
River RS Brand
Rotometals
Rubyfluid
Seaco
Shield-Arc
Shober
Sil-Aid
Sil-Bond
Sil-Ex
Sil-Fos
Sil-Lo
Sil-Lon
Sil-Loy
Sil-Old
Sil-Tex
Sil-Tite
Sil-Trode
S-M-S Alloys
Softweld
Solderall
Stain-Craft
Stainlend
Stainweld
Steel-Tectic
Stoodite
Stoody
Stoody Self-Hardening
Stoody Tube Borium
Supreme
Surfaceweld "A"
Temdco
Tensilend
Titan
Tool-Arc
Tool and Die
Toolface
Toolweld
Tri-Core
Trindl Speedweld
Tube Stoodite
Tube Tungsite
Tungrod
Tungweld
Unimetal
Vertex
Washcote
Wear-Arc
Weld-Arc

WOODS

American
Armorply
Benelex "70"
Dens-Tech
Die-Tech
Farlite Compreg
Fybr-Tech
Haskelite
Jamestown
Lignum-Vitai
Malarkey Plywoods
Mesh-Tech
Pamudo
Phemaloid
Pluswood
Plymold
Ply-Tech
Preg-Tech
Presdwood
Sweet Home Brand
Syrocowood
Weldwood
Woodex
Woodite

ZINC BASE

Apex
Doler Zink
Horsehead Zamak
Eraydo
Illinois
Precision
Zilloy

ZIRCONIUM BASE

Zirmet

Materials Producers

Producing companies listed alphabetically along with types and tradenames produced.
(For data on characteristics and applications of tradenamed materials, see Page 252)

Acme Steel Co., 2840 Archer Avenue, Chicago 8, Ill.
Colored strip steel—COLORSTRIP
Strip steel—ACME STRIP

Acushnet Process Co., 762 Belleville Ave., New Bedford, Mass.
Molded rubber parts and products to order—ACUSHNET

Adams Co. Inc., R. P., 225 E. Park Dr., Buffalo 17, N. Y.
Molded ceramic tubes—PORO-STONE

Advance Foundry Co., The, 107 Seminary Ave., Dayton, O.
Alloyed high strength cast gray iron — STRENES C

Agaloy Tubing Co., Springfield, O.
Carbon steel, alloy steel, stainless steel, Monel, Inconel, nickel and composite tubing—AGALOY

Air Reduction Sales Co., Div. Air Reduction Co. Inc., 60 E. 42nd St., New York 17.
Welding electrodes and gas welding rods—AIRCO
Hardfacing alloys—AIRCOLITE, AIRCO, AIRCOLOY

Ajax Metal Co., 46 Richmond St., Philadelphia 23, Pa.
Copper-base alloys—TOMBASIL

Akron Bronze & Aluminum Co., The, Box 109, Akron 9, O.
Beryllium-copper sand castings—VICULOY

Aladdin Rod & Flux Mfg. Co., 1300 Burton St., S.E., Grand Rapids 7, Mich.
Welding and brazing rod—ALADDIN ROD

Al-Fin Div., Fairchild Engine and Airplane Corp., Farmingdale, N. Y.
Aluminum bonded to steel and iron—AL-FIN

Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.
Stainless steels—ALLEGHENY METALS
Special alloy tool steels—ATLAS No. 93, PYTHON, SEMINOLE HARD, TETON, TIOGO
Nondeforming tool steel—DEWARD
Carbon tool steel—POMPTON
Electric steels — DELTAMAX, ALLEGHENY LUDLUM, MONIMAX, VANADIUM PERMENDUR, MOLYBDENUM PERMALLOY, MUMETAL, OHMALOY and SEALMET
Mild and stainless steel — ALLEGHENY METAL, STAINLESS CLAD
Silicon - Manganese steels — ALLEGHENY GRADE 609.

Allied Weld-Craft, Inc., 401 W. South St., Indianapolis 25, Ind.
Arc welding electrodes—ARC-CRAFT, STAIN-CRAFT

Alloy Engineering & Casting Co., Victor Ave., Champaign, Ill.
Stainless and heat-resistant castings—ACCOLOY

Alloy Metal Wire Co., Moore's Station, Prospect Park, Pa.
Stainless steels—ALMET
Electrical resistance alloy wire—ALRAY A, ALRAY C, ALRAY D, EXCELSIOR
Nickel clad copper wire—NI CLAD

Alloy Precision Castings Co., E 45th St. and Hamilton Ave., Cleveland 14, O.
Aluminum castings—NEMALOY

Alloy Rods Co., York, Pa.
Welding electrodes—ARCALOY, NICKEL-ARC, BRONZE-ARC, TOOL-ARC, WEAR-ARC, WELD-ARC and CHROME-BORIDE

Alloys & Products Inc., Oak Point Ave. & Barry St., New York 59.
Nonferrous alloys—ALPRO

Alloys Development Co., Pittsburgh, Pa.
Alloy steels—ALDECOR

Alpha Metals, Inc., 363 Hudson Ave., Brooklyn 1, N. Y.
Rosin filled solder—TRI-CORE

All-State Welding Alloys Co. Inc., 273 Ferris Ave., White Plains, N. Y.
Welding and brazing rods and solders — ALL-STATE

Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh.
Aluminum alloys—ALCOA and ALCLAD
Magnesium alloys—MAZLO

Aluminum Industries Inc., Cincinnati.
Aluminum-base alloy castings—PERMITE

Amalgamated Steel Corp., 7835 Broadway Ave., Cleveland 5, O.
Special analysis tool steels—KROMAL Nos. 2, 3 and 4, T.R.S.-R.M., RED CIRCLE, MALGA NON-TEMPERING SPECIAL, MALGA M.R.O. SPECIAL, MALGA ELEKTRO SPECIAL, and MALGALOY

American Agile Corp., 5806 Hough Ave., Cleveland 3, Ohio.
Welding electrodes—AGILE

American Brass Co., Waterbury, Conn.
Copper-aluminum alloy—AVIALITE
Copper-aluminum alloy—AMBRALOY
Copper-aluminum-nickel alloy—TEMPALOY
Copper - base alloys — AMBRAC, TOBIN BRONZE, ANACONDA, EVERDUR
Copper-nickel alloy—ANACONDA Cupro-nickel 754

American Cast Iron Pipe Co., 2930 N. 16th St., Birmingham 2, Ala.
Cast irons and steels—ACIPCO

American Cladmetals Co., P. O. Box 544, Carnegie, Pa.
Clad metal—ROSSLYN METAL

American Crucible Products Co., 1301 Oberlin Ave., Lorain, O.
Bearing bronzes—PROMET

American Cyanamid Co., Plastics Dept., 30 Rockefeller Plaza, New York 20.
Urea-formaldehyde plastics—BEETLE
Melamine-formaldehyde plastics—MELMAC
Unsaturated polyester resin—LAMINAC

American Electro Metal Corp., 320 Yonkers Ave., Yonkers 2, N. Y.
Steel powder-metal parts—SINTEEL

American Felt Co., Glenville, Conn.
Felt—"K" FELT and AMERICAN FELT
Rubberized and press laminated felt—VISTEX
Rubberized felt—FELTAN

American Foundry & Machine Co., P. O. Box 300, Salt Lake City, Utah.
Alloy steel castings—UTALOY

American Hard Rubber Co., 11 Mercer St., New York 13.
Hard rubbers—ACE
Plastics—PARIAN, ACE SARAN, PARNAL, PARSAN

American Lava Corp., 219 Kruesi Bldg., Chattanooga 5, Tenn.
Ceramics—AlSiMag

American Manganese Steel Div. of American Brake Shoe Co., 389 E. 14th St., Chicago Heights, Ill.
Alloy steel castings—AMSCO, CHROMANAL
Welding rods and electrodes — AMSCO, CHROMEFACE, DIEWELD, ECONOMY HARDFACE, FARMFACE, MO-MANG, NI-HARD, RAILFACE, RESISTWEAR, TOOLFACE, TUBE TUNGSITE

American Manganese Bronze Co., Holmesburg, Philadelphia 36, Pa.
Aluminum bronzes—RESISTAC
Aluminum manganese bronzes—HY-TEN-SL

American Nickeloid Co., 23 Second St., Peru, Ill.
Prefinished bonded - sheet and strip — NICKELOID, CHROMALOID, BRASSOID; American Bonded Metals

American Non-Gran Bronze Co., Berwyn, Pa.
Bronze—NON-GRAN

American Platinum Works, The, Newark, N. J.
Silver brazing alloys and fluxes, fine, coin and sterling silver, platinum metals and their alloys—APW

American Plastics Corp., 225 W. 34th St., New York 1.
Casein thermoplastics—AMEROID

American Tank & Fabricating Co., 2284 Scranton Rd., Cleveland, O.
Steel—AMERA-MAG

Atlas Foundry Co., 517-533 Lyons Ave., Irvington 11, N. J.
High-strength gray irons—AFCOMET

American Plywood Corp., New London, Wis.
Phenolic urea plywood — AMERICAN PLYWOOD

American Products Mfg. Co., Oleander and Dublin Sts., New Orleans.
Cellulose derivatives thermoplastic—INCELOID
Plastic adhesives—INCELOID

American Smelting & Refining Co., Equitable Bldg., New York.
Cadmium-nickel bearing alloy—ASARCOLOY No. 7.
Lead-bearing alloy—"G" ALLOY

American Steel & Wire Co., Rockefeller Bldg., Cleveland.
Carbon steels and alloys—U. S. S. AMERICAN QUALITY
Cold-finished steel bars—U. S. S. AMERCUT
High-strength steels—U. S. S. COR-TEN
Stainless steels—U. S. S. STAINLESS

American Steel Foundries, Avenue "L" & Herbert St., Newark 5, N. J.
Alloy steel castings—AMERICAN

American Wringer Co. Inc., Woonsocket, R. I.
Rubber and rubber synthetics—TENSILASTIC

Ampco Metal, Inc., 1745 S. 38th St., Milwaukee 46, Wis.
Wear, corrosion and shock-resistant copper-base alloys—AMPCO METAL
Copper-base alloys—AMPCOLOY
Coated aluminum bronze welding rods — AMPCO-TRODE
Coated silicon-bronze welding rod—SIL-TRODE
Coated phosphor-bronze electrode — PHOS-TRODE
High electrical conductivity alloys—AMPCO WELD

Amplex Mfg. Co., Div. of Chrysler Corp., Detroit 31, Mich.

Bearing bronze—OILITE
Bearing iron alloy—SUPER-OILITE
Bearing iron—IRON OILITE
Bearing iron, hardened—SUPER-OILITE "16"
Bearing stainless steel—STAINLESS STEEL OILITE
Filter elements—OILITE FILTERS
Friction materials, porous metal — OILITE FRICTION MATERIALS

Anchor Drawn Steel Co., Latrobe, Pa.
High-carbon steel drill rod—RED ANCHOR, BLUE ANCHOR, GOLD ANCHOR and ANCHOR Carbon-Vanadium

Apex Smelting Co., 6700 Grant Ave., Cleveland 5, and 2537 W. Taylor St., Chicago 12.
Aluminum casting alloys—ALLCAST No. 60, TERNALLOY, and RED X
Aluminum, zinc and magnesium alloys—APEX

Apollo Metal Works, 6605 South Oak Park Ave., Chicago 38.
Prefinished cold-rolled steel—APOLLO

Aero Chemical Products Corp., Cleaveland Industrial Center, Parker Rd., Fairmount, Long Valley, N. J.
Vinyl resin coatings—CLEARSEAL

Arcos Corp., 1500 S. 50th St., Philadelphia 43, Pa.
Stainless arc-welding electrodes—ARCOS
Arc-oxygen cutting rods—OXYCUTTEND
DC arc-welding electrodes—CHROMEND
AC-DC arc-welding electrodes—STAINLEND
Low-alloy high-tensile steel electrodes—TENSILEND

Armco Steel Corp., Middletown, O.
Stainless steel bar, wire, sheet, strip, plate, angles, special shapes; electrical steel sheet and strip; galvanized, Zincgrip and Zincgrip-Paintgrip sheet and strip; Aluminized steel sheet and strip; hot and cold-rolled sheet and strip, long ternes, enameling iron; mechanical electric weld tubing—ARMCO

Armstrong Cork Co., Lancaster, Pa.
Cork composition, cork-and-rubber compositions, synthetic rubber compounds, rag felt papers, and cork-and-synthetic-rubber compositions—ARMSTRONG'S
Industrial adhesives—ARMSTRONG'S

Arnold Engineering Co., The, Box G, Marengo, Ill.
Permanent magnet alloys—ALNICO, CUNIFE, CUNICO
Electrical steel—DELTAMAX

Athenia Steel Co., Div. of National Standard Co., Clifton, N. J.
High-carbon steels — ATHENIA Steel

Atlantic Foundry Co., The, 182 Beaver St., Akron 4, O.
Iron castings—AFCOLOY METAL

Atomized Materials Co. Inc., MD-200 Magee Bldg., Pittsburgh 22.
Liquid solder—KWIKMETAL

Aurora Metal Co., 614 W. Park Ave., Aurora, Ill.
Aluminum bronze die castings—AUR-O-MET

Austenal Laboratories, Inc., 715 E. 69th Place, Chicago 37, Ill.
Investment castings—AUSTENAL

Babcock & Wilcox Co., The, Refractories Div., 85 Liberty St., New York 6.
Firebrick—B & W Firebrick

Babcock & Wilcox Tube Co., The, Beaver Falls, Pa.
Steel tubes—NICLOY
Steel and stainless tubing—B & W CROLOY

Babcock & Wilcox Co., The, 85 Liberty St., New York 6, N. Y.
Wear-resisting, heat-resisting cast steels and cast iron—ELVERITE and B & W 5202

Bakelite Division, Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17.
Phenolic, urea, polystyrene resins and plastics—BAKELITE
Vinyl chloride-acetate, vinyl acetate and vinyl butyral resins and plastics—VINYLITE

Baker & Co. Inc., 113 Astor St., Newark 5, N.J.
Platinum, palladium, gold, silver and their alloys—BAKER and PLATINUM-CLAD

Baker Oil Tools, Inc., Box 2274, Terminal Annex, Los Angeles, 54.
Plastics resins—BAKER CASTING RESIN and BAKER IMPREGNATING RESINS

Baldwin Locomotive Works, The, Philadelphia 42, Pa.
Bronze—CRAMP'S Superstrength Bronze

Bearium Metals Corp., 266 State St., Rochester, N. Y.
Bearing bronzes—BEARIUM METAL

Belle City Malleable Iron Co., Racine, Wis.
Pearlitic malleable iron—BELMALLOY
High-strength malleable iron—BELECTROMAL
Electric-furnace-melted cast iron—BELECTRIC

Bendix Aviation Corp., Metal Hose Dept., Teterboro, N. J.
Seamless flexible metal hose—ECLIPSE and BENDIX

Beryllium Corp., The, Reading, Pa.
Beryllium coppers—BERYLCO 10, BERYLCO 10C, BERYLCO 20C, BERYLCO 25S, BERYLCO 275C

Bethlehem Steel Co., Bethlehem, Pa.
Butt-welded steel pipe — AMMONODUCT, BETH-CO-WELD and RAYDUCT
Zinc-coated steel wire—BETHANIZED
Copper-steel sheets—BETH-CU-LOY
Tin plate—BETH-CO-LITE
High tensile steel wire—BETHTELDUCTOR, RURALDUCTOR
Low alloy, high-strength steel—MAYARI R
Spring steel—SILVER STAR
Steel wire—BETHCO
Steel plate—BETHLOC
Wire rope—PURPLE STRAND

Binney Castings Co., 2745 Avondale Ave., Toledo 7, O.
Heat-resisting castings — MIN-OX, BINNEY METAL

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Steel castings—BIRDSBORO

Ernst Bischoff Co. Inc., Plastics Div., Ivoryton, Conn.
Thermoplastic potting materials—CLIDERITE

Bliss & Laughlin Inc., Buffalo, N. Y., Harvey, Ill.; Mansfield, Mass.
High sulphur bessemer steel—ULTRACUT
Cold finished steels—STRAIN-TEMPERED

Bohn Aluminum & Brass Corp., Lafayette Bldg., Detroit.
Light-aluminum alloy—BOHNALITE

H. Boker & Co., Inc., 101 Duane St., New York 7.
Tool steel—INTRA, KINITE
Die steel—OILWAY
High-speed steel—NOVO SUPERIOR

Bolivar Welding Wire Co., Bolivar, Pa.
Welding rods and electrodes—SUPREME

Bonney Floyd Co., The, Columbus 7, O.
Steel castings—MM

Booth Felt Co., 444 19th St., Brooklyn, N. Y.
Wool base felt—BOOTH

Borden Co., The, Chemical Division, 350 Madison Ave., New York 17.
Phenol-formaldehyde and phenol-furfural plastics—DURITE

Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.
Bearing bronzes—BOUND BROOK and COMPO
Porous iron bearing alloys—POWDIRON
Iron and bronze powder metal parts

Brach Mfg. Corp., Div. of General Bronze Corp., 200 Central Ave., Newark, N. J.
Solder in paste form—SOLDERALL

Braeburn Alloy Steel Corp., Braeburn, Pa.
High strength alloy steels—PRESSUREDIE No. 2 and SUPERIOR No. 3
High-speed tool steel—CONGO
High-speed tool steel—BRAEMOW M-2

Brake Shoe & Castings Div., American Brake Shoe Co., 230 Park Ave., New York
Ni-Cr alloy steel castings—ABK metal

William Brand & Company, 276 Fourth Ave., New York 10.
Varnished insulating material—TURBO
Plastics—TURBO

Brandywine Fiber Products Co., 15th and Poplar Sts., Wilmington, Del.
Vulcanized fiber, phenol fiber, paper and canvas-base material—BRANDYWINE

Bridgeport Brass Co., Bridgeport, Conn., and Indianapolis, Ind.
High-copper aluminum bronzes—DURONZE
Copper and zinc alloys—BRIDGEPORT
Tubing—BRIDGEPORT TUBING
Silicon bronze—BRIDGEPORT
Brass rod, free cutting—BRIDGEPORT LEDRITE

Brighton Electric Steel Casting Co., Beaver Falls, Pa.
Alloy steel castings—BESCOLOY

B & S Bronze Foundry, Inc., 76 Sedgwick St., Brooklyn 2, N. Y.
Aluminum castings—HYTENAT

Brush Beryllium Co., The, 4301 Perkins Ave., Cleveland 3, O.
Beryllium coppers — CONDULOY and No. 6

Buchsbaum & Co., S., 1737 So. Michigan, Chicago 16.
Vinylidene chloride and vinyl chloride acetate copolymers—ELASTI-GLAS

Buffalo Wire Works Co., Inc., 430 Terrace, Buffalo.
Wire cloth—BUFFALO

Buflovak Equipment Div., Blaw-Knox Co., 1543 Fillmore Ave., Buffalo 11, N. Y.
Alloy cast iron—BUFLOKAST

Bundy Tubing Co., 8109 E. Jefferson, Detroit.
Tubing of steel, Monel and "L" nickel—BUNDYWELD

Bunting Brass & Bronze Co., 715 Spencer St., Toledo 9, O.
Bearing bronzes—BUNTING

Byers Co., A. M., Clark Bldg., Pittsburgh 30.
Wrought iron—BYERS

Cadman, A. W., Mfg. Co., 2816 Smallman St., Pittsburgh.
Nickel-bronze alloy—NICUITE
Babbitt metals—BEARITE and ACORN
Copper base alloy—CUPALOY

California Cold Rolled Steel Corp., 7140 Telegraph Rd., Los Angeles 22, Calif.
Cold-rolled strip steel—CALSTRIP

Calorizing Co., 400 Hill Ave., Wilkinsburg, Pittsburg, Pa.
Heat-resisting cast steels—CALITE

Calumet Steel Castings Corp., 1636 Summer St., Hammond, Ind.
Alloy steel castings—CALUMETAL
Carbon steel castings—CASTEEL

Cambridge Wire Cloth Co., Cambridge, Md.
Wire cloth—CAMBRIDGE

Carboloy Co., Inc., 11177 East 8-Mile Rd., Detroit.
Cemented carbides—CARBOLOY
Special metals—ALNICO, HEVIMET, VECTOLITE, SILMANAL, CUNIFE, CUNICO

Carlon Products Corp., The, 10225 Meech Ave., Cleveland 5, Ohio.
Polyethylene plastic tube and pipe—CARLON

Carnegie-Illinois Steel Corp., Carnegie Bldg., Pittsburgh.
Abrasion resisting steels—U. S. S AR STEEL
Alloy steels—U . S . S CARILLOY
High strength steels — U . S . S COR-TEN U . S . S TRI-TEN steels, U . S . S MAN-TEN
Stainless Steels—U . S . S STAINLESS
Sheet steels—U . S . S
Free-machining bar stock—U . S . S MX

Carpenter Steel Co., Reading, Pa.
Stainless and specialty alloy steels—CARPENTER
Low expansion alloys—CARPENTER INVAR "36" and CARPENTER FREE-CUT INVAR "36"
Electrical and magnetic alloys—CARPENTER HIGH PERMEABILITY "49" and HyMu "80"
Glass sealing alloys—CARPENTER GLASS SEALING "27" and "42"

Catalin Corp. of America, 1 Park Ave., New York.
Bonding resin—CATABOND

Celanese Corp. of America, Plastics Div., 180 Madison Ave., New York 16.

Cellulose acetate plastics—LUMARITH
Cellulose propionate plastic—FORTICEL
Wire mesh reinforced plastics—VIMLITE
Cellulose acetate sheets reinforced with wire—LUMAPANE

Central Paper Co., Inc., 2400 Lakeshore Drive, Muskegon 28, Mich.
Wood-cellulose fiber material — CENTRALINE

Centrifugal Foundry Co., Muskegon, Mich.
Alloy iron castings—CENTRALLOY

Cerro de Pasco Copper Corp., 40 Wall St., New York, N. Y.
Low-melting-point alloys — CERROBASE, CERROBEND, CERROMATRIX, CERROLOW, 117, CERROSAFE, CERROTRU
Metal-to-glass solder—CERROSEAL

Chace Co., W. M., 1616 Beard Ave., Detroit 9.
Thermostatic bimetals—CHACE

Chain Belt Co., 1643 W. Bruce St., Milwaukee 4.
High tensile, corrosion-resistant casting — REX Z METAL

Chase Brass & Copper Co., Waterbury 20, Conn.
Corrosion-resistant copper alloys — CHAMET BRONZE, CHASE TELLURIUM COPPER, and CHASE PHOSNIC BRONZE.
High tensile strength bronze—TELNIC

Chicago Malleable Castings Co., 1225 West 120th St., Chicago 43, Ill.
Alloy malleable castings—SUPER Y

Chicago Powdered Metal Products Co., 9341 Irving Park Rd., Schiller Park, Ill.
Custom-molded powder-metal parts—CAMET

Chicago Rawhide Mfg. Co., 1301 Elston Avenue, Chicago 22, Ill.
Synthetic rubber—SIRVENE
Mechanical leather—SIRVIS

Chicago Steel Foundry Co., Kedzie Ave. and 37th St., Chicago 32.
High tensile strength castings—EVANSTEEL and PYRASTEEL

Chicopee Mfg. Corp. of Georgia, 40 Worth St., New York, N. Y.
Industrial fabrics—LUMITE

Ciba Co. Inc., 627 Greenwich St., New York 14.
Aniline formaldehyde resin—CIBANITE

Cincinnati Industries Inc., 501 Station Ave., Lockland, Cincinnati.
Phenol formaldehyde thermosetting plastic—X-CREPE Resin

Cleveland Electro Metals Co., The, 2391 W. 38th St., Cleveland 13.
Aluminum alloys—CEMCO and LECTROPAT

Cleveland Tungsten Inc., 10200 Meech Ave., Cleveland.
Copper-tungsten electrodes—CLETALOY
Tungsten—CLEVE-TUNGSTEN
Molybdenum bars, wire, sheet and powder metal—CLEVE-TUNG

Climax Molybdenum Co., The, 500 Fifth Ave., New York 18, N. Y.
Molybdenum alloying element — MOLYBDENUM

Coast Metals, Inc., Canton 6, O.
Hard facing alloys—COAST METALS
Iron and nickel-base casting alloys—COAST METALS

Cold Metal Products Co., Youngstown, Ohio.
Carbon, alloy and stainless strip steel—THINSTEEL

Colonial Insulator Co., The, 973 Grant St., Akron, O.
Ceramic material—COLONIAL

Columbia Steel Co., Russ Bldg., San Francisco 6.
Abrasion-resisting steels—U · S · S AR STEEL
Alloy steels—U · S · S CARILLOY
High strength steels — U · S · S COR-TEN, U · S · S MAN-TEN, U · S · S TRI-TEN
Sheet steels—U.S.S.
Stainless steels—U · S · S STAINLESS
Spring steel wire—U · S · S PREMIER
Mechanical tubing—U · S · S SHELBY

Columbia Steel & Shafting Co., P. O. Box 1557, Pittsburgh 30.
Cold finished steel bars and shafting; drawn, turned and polished. Standard and special shapes. All standard AISI grades in carbon and alloy steel

Columbian Rope Co., Auburn, N. Y.
Needled sisal pads—CO-RO-FELT

Commercial Steel Casting Co., 1205 Cheney Ave., Marion, O.
Steel castings to specification—COMMERCIAL

Connecticut Hard Rubber Co., The, 407 East St., New Haven, Conn.
Silicone rubbers—COHRLASTIC

Consolidated Water Power & Paper Co., Wisconsin Rapids, Wisc.
Laminated plastics—CONSOWELD

Continental-Diamond Fibre Co., Newark 23, Del.
Phenolic plastics—DILECTO, CELORON, MECOBOARD and DILECTO Glass Fabric
Electrical insulating material—VULCOID
Vulcanized fiber—DIAMOND
Shellac thermosetting material—CELLULAK
Mica material—MICABOND

Continental Foundry & Machine Co., East Chicago, Ind. and Pittsburgh, Pa.
Iron alloy rolls—CROMONITE and CRASFLOY
Carbon steel and alloy steel rolls—CONTINENTAL

Continental Rubber Works, 2000 Liberty St., Erie, Pa.
Mechanical rubber—CONTINENTAL

Continental Steel Corp., Kokomo, Ind.
Copper steel sheet—CONTINENTAL, DULLCOAT
Copper-nickel-chromium sheet—KONIK
Steel sheet—GALVANNEALED

Cooper Alloy Foundry Co., The, Bloy St. & Ramsey Ave., Hillside, N. J.
Metal alloy castings—COOPER ALLOYS

Copperweld Steel Co., Glassport, Pa.
Copper covered steel—COPPERWELD
Alloy steels—ARISTOLOY

Corning Glass Works, Corning, N. Y.
Glass materials — CORNING, PYREX and VYCOR

Crescent Smelting Works, Inc., 232 Seigel St., Brooklyn 6, N. Y.
Solder—CRESCENT

Crowley & Co., Henry L., West Orange, N. J.
Steatite and other ceramics—CROLITE
Powder iron—MAGICORES
Powder metal—CROWLEY
High perm metals—CROLOY

Crucible Steel Casting Co., Almira Ave., and W. 84th St., Cleveland.
Sand castings—PAR

Crucible Steel Co. of America, Atha Works, Harrison, N. J.
Hard surfacing welding rods—REXWELD A, B, and C
High alloy castings—REXALLOY
Low alloy steel—HY-TUF
Carburizing steel—CRUCIBLE
Tool steels—GRANADA
Stainless steels—CRUCIBLE

Cumberland Steel Co., 101 Williams St., Cumberland, Md.
Turned and ground steel—CUMBERLAND

Cutler-Hammer Inc., 12th & St. Paul, Milwaukee.
Cold-molding plastics—THERMOPLAX

Cuyahoga Steel & Wire Co., The, Longwood Ave., Maple Heights, O.
Cold-drawn steels—CUYO

Darbyshire Steel Co. Inc., El Paso, Tex.
Martensitic nickel cast iron—NI HARD
Austenitic nickel cast iron—NI RESIST

Davidson Rubber Co., Boston 29, Mass.
Sponge rubber—CUSH-N-FIT

Joseph Davis Plastics Co., Arlington, N. J.
Plastics—JODA, and JODAPAC

Densewood Corp., The, Elkhorn, Wis.
Impregnated wood—DENSEWOOD

Detroit Gray Iron Foundry, 282 Iron St., Detroit 7, Mich.
Iron alloy casting—LEKTROKAST

Dewey & Almy Chemical Co., 62 Whittemore Ave., Cambridge 40, Mass.
Sealing compound—DAREX

Dirilyte Co. of America, Inc., 1142 S. Main St., Kokomo, Ind.
Aluminum-bronze alloys—MOLIN METAL

Dodge Cork Co. Inc., Manor & Laurel Sts., Lancaster, Pa.
Composition cork—DODGE

Dodge Steel Co., Tacony, Philadelphia 35.
Electric steel castings—DODGE

Doehler-Jarvis Corp., 386 Fourth Ave., New York 16, N. Y.
Copper-zinc-silicon die casting alloys—DOLER-BRASS
Magnesium base die casting alloys—DOLER-MAG
Aluminum base die casting alloys—DOLER-ALUMINUM, DOLER-ALSILOY #1, DOLER-ALSILOY #9, and DOLER-ALSILOY #10
Zinc base alloys—DOLER-ZINK

Dow Chemical Co., The, Midland, Mich.
Thermoplastic granules—ETHOCEL, STYRON and SARAN
Magnesium and magnesium alloys — DOW-METAL

Dow Corning Corp., Midland, Mich.
Electrical insulating varnish—DOW CORNING DC 993 and DC 996
Silicone rubbers—SILASTIC
Silicone resins—DOW CORNING DC 2103
Silicone lubricants—DOW CORNING DC 550, DC 710, DC 33, DC 41 and DC 44
Silicone compounds—DOW CORNING DC 4
Silicone fluids—DOW CORNING DC 200, DC 702 and DC 703

Draper Bros. Co., Canton, Mass.
Felt—DRAPER

Driver Co., Wilbur B., Riverside Ave., Newark, N. J.
Copper-nickel alloy—CUPRON
Nickel-chromium alloy—TOPHET

Driver-Harris Co., Harrison, N. J.
Heat and electrical resisting alloys—ADVANCE, NILVAR, CHROMAX, CIMET, NICHROME and NICHROME V, HYTEMCO, KARMA, MANGANIN

Dunbar Glass Corp., Dunbar, W. Va.
Industrial glass cylinders and parts to specification—DUNBAR

Du Pont de Nemours, E. I., & Co. Inc., Polychemicals Dept., Wilmington, Del.
Acrylic resin—LUCITE
Tetrafluoroethylene polymer—TEFLON
Polyamide thermoplastic—NYLON
Polyethylene thermoplastic—POLYTHENE

duPont de Nemours, E. I. & Co., Inc., Wilmington 98, Del.
Plastic-coated wire mesh—CEL-O-GLASS
Nitrocellulose base—PYRALIN
Cellulose acetate base—PLASTACELE
Polyvinyl alcohol—ELVANOL
Polyvinyl acetate—ELVACET
Polytetrafluoroethylene—TEFLON
Polyvinyl butyral—BUTACITE
Chloroprene synthetic rubber—NEOPRENE

Duraloy Company, The, Scottdale, Pa.
Chromium steel—DURALOY

Durez Plastics & Chemicals Inc., North Tonawanda, N. Y.
Phenolic plastics—DUREZ

Duriron Co., Inc., Dayton, O. (and Licensees—see Duriron in tradename listing).
Corrosion and heat-resistant alloy castings—DURICHLOR, DURIMET 20, DURIRON, DURCO, CHLORIMET 2 and 3.

Eastern Malleable Iron Co., The, Naugatuck, Conn.
Cast ferrous metals—EASTERN
Nickel-chrome alloys—EASTERN

Eastern Stainless Steel Corp., Baltimore 3, Md.
Stainless steel sheets—ES

Eimco Corp., The, P. O. Box 300, Salt Lake City 8, Utah.
Chrome-molybdenum steel castings—UTALOY

Electric Steel Castings Co., Speedway, Indianapolis, Ind.

Alloy steel castings—DUC-TEN

Electric Steel Foundry Co., 2141 N. W. 25th Ave., Portland 10, Oreg.
Cast steels—ESCO

Electro-Alloys Div., American Brake Shoe Co., Elyria, O.
Ni-Cr alloy steel castings—THERMALLOY
High alloy steel castings—THERMALLOY HC 250
Stainless steel castings—CHEMALLOY
High-alloy cast iron — CHEMALLOY N SERIES

Electro Metallurgical Div., Union Carbide and Carbon Corp., 30 East 42nd St., New York 17, N. Y.
Ferro-alloys and alloying elements—ELECTROMET

Elgin National Watch Co., Elgin, Ill.
Cobalt alloy—ELGILOY

Empire Steel Castings, Inc., Reading, Pa.
Steel casting alloys—ISOCAST

Enjay Co. Inc., 15 W. 51st St., New York 19.
Buna N-type rubber—PARACRIL
Polyisobutylene elastomer—VISTANEX
Styrene-isobutylene copolymer—S-POLYMER

Ensign Products Co., 3528 E. 76th St., Cleveland 5, O.
Aluminum solders—ENSIGN
Die-cast welding alloy—ENSIGN 64

Erickson Electronic Sales Co., 1417 Seventh St., Rockford, Ill.
Welding electrodes—NICROMOL

Erie Malleable Iron Co., 621 West 12th St., Erie, Pa.
Abrasion and wear-resisting cast irons — ERMAL and ERMALITE

Eutectic Welding Alloys Corp., 40 Worth St., New York 13.
Welding alloys, cutting electrodes and fluxes—BRONZOCHROM, EUTECTIC, EUTECROD, EUTECTRODE, EUTECHROM, EUTECTOFILM, CUTTRODE, HAND-OMATIC, STEEL-TECTIC, STRAINTRODE, EUTECSTRAIN ROD

Everhot Products Co., 2001-09 W. Carroll Ave., Chicago 12, Ill.
Copper-fused and copper coated steel tubing—BUNDYFLEX

Extruded Plastics Inc., Norwalk, Conn.
Thermoplastic tubing—TULOX

Fabreeka Products Co., 222 Summer St., Boston 10, Mass.
Vibration and noise damping material — FABREEKA

Fabricon Products Inc., 1721 Pleasant Ave., River Rouge 18, Mich.
Resin impregnated papers and fabrics—PHENOPREG

Fahralloy Co., 149 St., E. Loomis Ave., Harvey, Ill.
High nickel-chrome steel—FAHRALLOY
Nickel irons—NI-RESIST

Falk Corp., The, 3001 W. Canal St., Milwaukee 8, Wis.
Alloy cast steel—MOLY-TELASTIC

Falls Hollow Staybolt Co., 7 E. Portage Trail, Cuyahoga Falls, O.
Wrought iron—FALLS

Fansteel Metallurgical Corp., North Chicago, Ill.
Corrosion-resistant, high-tensile-strength metals—FANSTEEL

Farley & Loetscher Mfg. Co., Dubuque, Iowa.
Phenolic and melamine plastics—FARLITE
Fabric base, thermosetting plastics—FARLITE

Farrell Cheek Steel Co., Sandusky, O.
Alloy steel castings—FARRELL'S

Federal Mogul Corp., 11031 Shoemaker Ave., Detroit.
Bearing bronzes—FEDERAL BRONZES
Babbitt bearing alloys—MOGUL BABBITTS

Felters Co., The, 210 South St., Boston 11, Mass.
Noise and vibration damping material — UNISORB
Felts—FELTERS
Felt laminated with Neoprene—DUFELT

Felt Products Mfg. Co., 1503 Carroll Ave., Chicago 7.
Gaskets, packings, oil seals, die cut parts of copper, asbestos, steel material—FELPRO

Finkl & Sons Co., A., 2011 Southport Ave., Chicago 14.
Alloy steels—DURODI, CUPRODIE, SHELL DIE, and FINKL CNM, FS, FX

Firestone Tire & Rubber Co., Akron.
Synthetic rubber—BUTAPRENE

Firth Sterling Steel & Carbide Corp., McKeesport, Pa.
Sintered carbides—FIRTHITE, FIRTHALOY and DIECARB
Stainless steels; chrome-nickels—STERLING

Follansbee Steel Corp., Third and Liberty Aves., Pittsburgh 22, Pa.
Cold rolled strip steel—FOLLANSBEE

Foote Mineral Co., Inc., 18 West Chelten Ave., Philadelphia 44.
Ductile zirconium metal—ZIRMET

Formica Co., The, 4614 Spring Grove Ave., Cincinnati 32.
Laminated thermosetting plastics—FORMICA

Fort Pitt Steel Casting Div., Pittsburgh Steel Foundry Corp., McKeesport, Pa.
Stainless and heat-resisting castings—FORT PITT
Carbon and alloy steel castings—TUFALOY

Frank Foundries Corp., Moline, Ill.
Corrosion and abrasion-resistant iron alloys—FRANKITE

Franklin Fibre-Lamitex Corp., 190 E. 12th St., Wilmington, Del.
Laminated phenolic plastics—LAMITEX
Hard vulcanized fiber—FRANKLIN

Frontier Bronze Corp., 4870 Packard Road, Niagara Falls, N. Y.
Wear-resisting bronzes—FRONTIER

Furane Plastics & Chemicals Co., 719 W. Broadway, Glendale 4, Calif.
Plastic adhesive—RESIN X-2
Melamine formaldehyde plastic—CALCERITE

Fusion Engineering Co., 4500 Superior Ave., Cleveland, O.
Micro-film paste type alloys—FUSION

Garfield Mfg. Co., Garfield, N. J.
Thermosetting materials—GUMMON (black); HEMIT (gray-white); TEGIT (phenolic binder) and GARIT

Gatke Corp., 228 N. LaSalle St., Chicago 1.
Asbestos packing—AZTEC

Gemloid Corp., 7900 Albion Ave., Elmhurst, L. I., N. Y.
Tubing and gasketing material—GEMFLEX
Thermoplastic material—GEMLOID
Acrylic thermoplastic—GEMLITE
Decorative plastic—TRI-MENSIONAL PROCESS

General Ceramics & Steatite Corp., Keasbey, N. J.
Ceramic materials—CERAWARE, STEATITE, GENERAL CORDIERITE and TITANATES FERRAMIC "G"

General Electric Co., Chemical Dept., 1 Plastics Ave., Pittsfield, Mass.
Glass-bonded mica—G-E MYCALEX
Silicone rubbers—G-E
Silicone rubber-coated glass cloth—G-E
Pressed cotton gears—FABROIL
Laminated plastics—TEXTOLITE, G-E

General Electric Co., Electronics Dept., Syracuse, N. Y.
Special composite materials—MULTI-WEAVE

General Metals Powder Co., Akron, O.
Metallic friction materials—GEMPCO

General Plate Div., Metals & Controls Corp., Attleboro, Mass.
Thermostat metals—TRUFLEX
Composite aluminum-copper—ALCUPLATE
Manganese alloys—GENERAL PLATE No. 715 and No. 720

General Steel Castings Corp., Granite City, Ill., and Eddystone, Pa.
Steel castings—COMMONWEALTH

General Tire & Rubber Co., Mechanical Goods Div., Wabash, Ind.
Rubber—GENERAL
Composite rubber-metal—SILENTBLOC

Gibson Electric Co., 8355 Frankstown Ave., Pittsburgh 21.
Powder metal—GIBSILOY

Gilbert Brass Foundry Co., 5036 Farlin Ave., St. Louis 15, Mo.
Bearing bronzes—VELOX and MACHINERY BRONZE

Glacier Metal Co., Richmond, Va.
Bearing babbitt—GLACIER

Globe Steel Tubes Co., Milwaukee 46.
Seamless steel tubing—GLOBE
High purity ingot iron—GLOBEIRON
Stainless welded tubing—GLOWELD

Goodrich Chemical Co., B. F., Rose Bldg., Cleveland 15.
Polyvinyl chloride thermoplastic—GEON
American rubber—HYCAR
Rubber reinforcing resin—GOOD-RITE
Polyblend—GEON
Plastisizer—GOOD-RITE

Goodyear Tire & Rubber Co., Akron, O.
Synthetic rubber—CHEMIGUM
Plastic resin—PLIO-TUF
Vinyl chloride copolymer—PLIOVIC A and AO

Graphite Metallizing Corp., 1045 Nepperhan Ave., Yonkers 3, N. Y.
Carbon-graphite metal-impregnated material—GRAPHALLOY

Graphitized Alloy Corp., 5 Beekman St., New York 7.
Lead-base graphitized babbitt—GRAC

Graton & Knight Co., 356 Franklin St., Worcester 4, Mass.
Mechanical leathers—GRATON & KNIGHT

Great Lakes Steel Corp., Div. of National Steel Corp., Ecorse, Detroit, Mich.
High-strength, low-alloy steels—N-A-X

Gunite Foundries Corp., 302 Peoples Ave., Ave., Yonkers 3, N. Y. Rockford, Ill.
Processed cast irons, cast steels—GUNITE

Handy & Harman, 82 Fulton St., New York 7.
Brazing alloys — SIL-FOS, EASY-FLO and HANDY FLUX

Hanford Foundry Co., 119 S. Arrowhead Ave., San Bernardino, Calif.
Cast steels—DURITE and HASCALOY

Hardy Inc., Charles, 420 Lexington Ave., New York 17.
Powdered metal—HARDY Metal Powders
Permanent magnet powder—HARDYNE

Harnischfeger Corp., 4400 W. National Ave., Milwaukee 14, Wis.
Welding rods—HARTOP, HARCOTE, HARNIMANG, HARMOMANG, HARTUNG, HARCROME, HARSTAIN, DUSTCOTE, WASHCOTE, and LITECOTE

Harris & Co., Arthur, 212 N. Aberdeen St., Chicago 7.
Copper-nickel alloy—DAIRYWHITE
Bearing metal—HARRIS 80-10-10

Harris Products Co., 5105 Cowan Ave., Cleveland, O.
Rubber-metal composition—HARRIS SILENTBLOC

Harwick Standard Chemical Co., Akron, O.
Polystyrene plastics—PICCOLASTIC

Haskelite Mfg. Corp., Grand Rapids 2, Mich.
Resin-bonded plywoods—HASKELITE and PHEMALOID
Wood veneer on steel—ORNAMETL and PLYMETL

Haveg Corp., Newark 23, Del.
Furane and phenolic plastics—HAVEG

Haynes Stellite Div., Union Carbide and Carbon Corp., Kokomo, Ind.
Heat, corrosion and abrasion-resistant cobalt-chromium-tungsten—HAYNES STELLITE
Abrasion-resistant tungsten-carbide diamond substitute—HAYSTELLITE
Impact-resistant, iron-base, hard-facing rod—HASCROME
Nickel-base alloys—HASTELLOY
Hard-facing rods—HAYNES
Iron-base alloys—MULTIMET

Heppenstall Co., Hatfield St., Pittsburgh
Chromium steel—KLEENKUT and EIS 45
Chrome-nickel-molybdenum steel — HEPPENSTALL and EIS 57

Hercules Powder Co., Wilmington 99, Del.
Plastics—HERCULES

Heresite & Chemical Co., Manitowoc, Wis.
Phenol formaldehyde thermosetting plastics—HERESITE
Plastic coatings—HERESITE
Synthetic rubber—HERECROL RC

Hills-McCanna Co., 3025 N. Western Ave., Chicago.
Magnesium and aluminum alloy and castings—HILLS-McCANNA

Homalite Corp., The, 13 Brookside Drive, Wilmington 166, Del.
Thermosetting plastics—HOMALITE CR-39

Hoskins Mfg. Co., 4445 Lawton Ave., Detroit 8.
Nickel base and nickel-chrome alloys — CHROMEL

Houghton & Co., E. F., 303 W. Lehigh Ave., Philadelphia 33.
Synthetic rubbers—VIX-SYN
Leather—VIM

Houghton Laboratories Inc., Oleans, N. Y.
Thermosetting plastic—HYSOL 6000

Howard Foundry Co., Magnesium Div., Chicago.
High strength magnesium alloy—FLYLITE

Howard, J. W. and A. P., Co., Corry, Pa.
Leather—KORRY-CHROME

Hunt-Spiller Mfg. Corp., 383 Dorchester Ave., Boston 27.
Cast iron—HUNT-SPILLER Gun Iron, steel castings. Also Ni-RESIST, NI-HARD, MINOVAR, and carbon steels.

Hussey & Co., C. G., Div. of Copper Range Co., 2850 Second Ave., Pittsburgh.
High copper-base material—HUSSEY

Illinois Zinc Co., 2959 W. 47th St., Chicago 32,
Sheet and strip zinc—ILLINOIS and ERAYDO Alloy

Indium Corp. of America, 1676 Lincoln Ave., Utica, N. Y.
Lead-silver solder—INDIUM

Industrial Research Laboratories, Ltd., 961 E. Slauson Ave., Los Angeles 11.
Iron, nickel, boron alloy—XALOY
Nickel, cobalt, chromium, molybdenum alloys—XALOY-306

Industrial Synthetics Corp., Garwood, N. J.
Rubber-like synthetics—SYNFLEX, ELASTRON and VOLTRON

Ingersoll Steel & Disc Division, Borg-Warner Corp., 310 S. Michigan Ave., Chicago.
Stainless-clad steel—INGACLAD
Stainless steel—INGERSOLL

Inland Steel Co., 38 S. Dearborn St., Chicago 3.
Low-carbon titanium vitreous enameling steel—TI NAMEL
Low-alloy, high-strength, corrosion-resistant steel—HI-STEEL
Carbon steels, etc.—INLAND

Insulating Tube Co., Poughkeepsie, N. Y.
Plastics laminate—INTUC

International Graphite & Electrode Corp., St. Marys, Pa.
Graphite electrodes—INTERNATIONAL

International Nickel Co. Inc., 67 Wall St., New York 5 (and licensees).
Corrosion, heat and wear-resisting alloys—NI-TENSYLIRON, NI-HARD, NI-RESIST, NI-SPAN, NICKEL, MONEL and INCONEL and INCONEL X
Welding electrodes—NI-ROD, NI-ROD "55, and other high-nickel alloy electrodes and filler materials

International Powder Metallurgy Co., 439 Main St., Ridgeway, Pa.
Powder-metal parts—AUTOLUBE

International Textile Co., 2517 W. Twelfth St., Chicago, Ill.
Phenol formaldehyde plastic—FIBER PLAST

Irvington Varnish & Insulator Co., Irvington, N. J.
Flexible extruded plastics tubing—HYFLEX, IRV-O-LITE, XTE 30, IVI-FLEX and TRANSFLEX, FIBRON NO. 5373
Flexible varnished tubing — IRV-O-VOLT, RS and FV
Plastic insulating tape and tubing—FIBRON
Lacquered tubing—FV, RS
Insulating varnishes — IRVINGTON and HARVEL
Resins—CARDOLITE and FURATONE

Isolantite Mfg. Corp., Stirling, N. J.
Ceramic—ISOLANTITE

Illium Corp., Freeport, Ill.
Cast nickel alloy—ILLIUM G

International Packings Corp., Bristol, N. H., affiliated with Graton & Knight Co., Worcester, Mass.
Oil resistant rubber—GRAKONE

Jamestown Veneer & Plywood Corp., Box 581 G, Jamestown, N. Y.
Plywood—JAMESTOWN

Jeffrey Mfg. Co., The, First Ave. and Big Four R. R., Columbus 16, O.
High-strength alloy and processed irons — PERDURO, SUPERMAL, X SUPERMAL,
Alloy iron castings—JEFFREY 55M, JEFALOY A, NI-HARD

Jelliff Mfg. Corp., C. O., The, Southport, Conn.
One-piece solid metal plated screen—LEKTROMESH

Jessop Steel Co., 540 Green St., Washington, Pa.
Stainless steels—JESSOP

Jobbins, Inc., William F., P. O. Box 230, Aurora, Ill.
Aluminum casting alloys—JOBBINS Almag 35, JOBBINS 3-6 Supreme, JOBBINS 4-8 Supreme, JOBBINS 3-6-6 Supreme, and JOBBINS Almag 56

Johnson Bronze Co., New Castle, Pa.
Bearing metals—JOHNSON, LEDALOYL

Johnson Rubber Co., Middlefield, O.
Rubber—JOHNSON

Johnson Steel & Wire Co., 53 Wiser Ave., Worcester, Mass.
Music spring wire—XLO Brand

Johns-Manville, 22 E. 40th St., New York 16.
Diatomaceous silica material—CELITE
Rubbery, asphaltic-asbestos material—AERTITE
Asbestos, fiber, graphite and rubber compound—EEL-SLIP
Weatherproof coating—INSULKOTE
Refractory material—FIRECRETE, BLAZECRETE
Asbestos-cement sheets for electrical use. J-M TRANCELL, J-M ASBESTOS EBONY, J-M TRANSITE, J-M QUINTERRA, and J-M QUINORGO

Jones & Laughlin Steel Corp., Jones & Laughlin Bldg., Pittsburgh 30.
Free-machining steel—JALCASE
High-impact special steel—JALLOY
High-tensile, lightweight steel—OTISCOLOY
Cold-finished steel, cold-drawn shapes and tubing—J & L Steels

Kaiser Aluminum & Chemicals Corp., The, Kaiser Bldg., 1924 Broadway, Oakland 12, Calif.
Aluminum alloys—KAISER ALUMINUM

Kaiser Steel Corp., 1924 Broadway, Oakland, Calif.
Steel—KAISALOY

Keasbey & Mattison Co., Ambler, Pa.
Asbestos and magnesia insulations—HYTEMP and FEATHERWEIGHT

Kelly Foundry & Machine Co., Elkins, West Va.
High graphite cast iron—KELCAST MM
Mold iron—KELCAST

Kencroft Malleable Co., Inc., 373 Hertel Ave., Buffalo 7.
Ni-Cr pearlite malleable—JEWELL ALLOYS

Kennametal Inc., Latrobe, Pa.
Tungsten-titanium carbide—KENNAMETAL
Titanium carbides—KENTANIUM

Kensico Tube Co., Inc., Mt. Kisco, N. Y.
Copper tubing—KENSICO

Key Co., Box 494, East St. Louis, Ill.
Graphite paste—KEY
Oxygen sealing compound—ABSO-LUTE
Waterproof pipe-joint compound—KEY-TITE

Keyes Fibre Co., Waterville, Me.
Thermosetting phenol-formaldehyde plastics—KYS-ITE

Keystone Carbon Co., Saint Marys, Pa.
Self-lubricating porous bearing metal—SELFLUBE
Powder meal parts—KEYSTONE

Kidd Drawn Steel Co., West Aliquippa, Pa.
High carbon tool steel—AJAX
SAE grades, special alloys and open hearth and electric furnace tool steels—KIDD

Knight, Maurice A., Co., 175 Kelly Ave., Akron 9, O.
Resinous thermosetting plastics—PERMANITE
Thermosetting copolymer liquid for coating—SEALON

Koppers Co. Inc., Chemical Division, Koppers Bldg., Pittsburgh 19.
Adhesive for polystyrene—KOPPERS
Ethyl cellulose molding material—KOPPERS ETHYL CELLULOSE
Cellulose acetate molding material—KOPPERS CELLULOSE ACETATE
Polystyrene molding material — KOPPERS POLYSTYRENE
Adhesives—PENACOLITE

Kopp Glas Inc., Swissvale, Pa.
Industrial glass—KGI

Koppers Co. Inc., Metal Products Div., Piston Ring Dept., P. O. Box 626, Baltimore 3, Md.
Cast iron—K-SPUN

Koppers Co., Inc., Metal Products Div., P. O. Box 298, Baltimore 3, Md.
Bronze—D-H-S

Korfund Co. Inc., The, 48-15 32nd Pl., Long Island City 1, N. Y.
Vibration dampening materials—ELASTORIB and KORFUND

Krembs & Co., 669 W. Ohio St., Chicago 10, Ill.
Coated welding rods—FLUXINE and KOP-R-ARC

Lake City Malleable Co., The, 5048 Lakeside Ave., Cleveland 14.
Malleable iron—SHOCKPROOF

Laminated Plastics Inc., 1823 E 40 St., Cleveland 3.
Thermosetting polyester—GLASTIC

Laminated Shim Co. Inc., Union St., Glenbrook, Conn.
Laminated shim stock—LAMINUM

La Salle Steel Co., Hammond, Ind.
Steels—STRESSPROOF, TRITEX No. 2 (Thermalized), LA-SULPHITE 8640 and LA-LED

Lebanon Steel Foundry, Lebanon, Pa.
Steels—CIRCLE L

Lehigh Babbitt Co., Box 1004, Allentown, Pa.
Babbitt metal—GRAPHO

Lenk Mfg. Co., The, 30-38 Cummington St., Boston 15.
Solder—LENK SUPER ALUMINUM SOLDER

Lewin-Mathes Co., 1111 Chouteau Ave., St. Louis 2.
Copper and copper alloys and tubing—LMC

Libbey-Owens-Ford Glass Co., Nicholas Bldg., Toledo, O.
Window glass, bullet resisting glass, safety glass, polished plate glass—LOF High-tempered polished plate glass—TUF-FLEX
Transparent mirror—MIRROPANE
Glass with metal edge—THERMOPANE
Glass with thin electrical-conductivity film—ELECTRAPANE
Heat reducing glass—E-Z EYE

Lignum-Vitae Products Corp., 96-100 Boyd Ave., Jersey City, N. J.
Tropical wood—LIGNUM-VITAE

Lincoln Electric Co., 12818 Coit Rd., Cleveland.
Arc-welding electrodes—SHIELDARC, MAN-

Load Carrying Capacity

THE AMOUNT of weight or force a given bearing material can successfully support per square inch of its area is known as its load carrying capacity.

In general, the load carrying capacity of a material varies proportionally to its tensile strength and hardness on which basis steel would be an excellent bearing material. However, steel does not possess the low coefficient of friction, conformability and other properties required of a satisfactory bearing material. Thus, our discussion is limited to those metals or alloys which have proven suitable for bearing use, viz; the Babbitts, Copper Lead, Aluminum and Bronzes.

To choose the proper bearing material, many factors must be considered for each particular application. Probably the first decision that must be made is that of how much space can be allotted to the bearing. In some cases there are practically no space limitations, in others the bearing area must be kept at a minimum. Having calculated the projected bearing area—the product of the length of the bearing times its inside diameter—a second design limitation, the maximum force or loading which will be imposed on the bearing at any given instant, must be determined. Often times this process is reversed—with a known maximum load, the bearing area will be partially governed by the size shafting required to transmit the generated force. In either case, with the load and loaded area known, the bearing load per square inch can be found.

The table above indicates the load carrying capacity of the most widely used bearing alloys under varying operating conditions. As can be seen, the maximum loads change 100% or more as operating conditions become more severe. In fact, as the load is doubled, the bearing life is decreased approximately ten times. Normal operation can be described as operation at a moderate range of engine speeds with intermittent stops and starts—average automotive operations. Heavy duty operation means continued high speeds and very heavy loads as obtained in a heavily loaded "high-balling" truck or an automobile operated beyond a reasonable speed. The maximum allowable load, as indicated by the short bearing life, can only be tolerated for short, widely spaced periods of operation.

The distinction is made between the so-called conventional babbitts and the thin babbitts due to the factor of relative fatigue strengths. It has been found that

LOAD CARRYING CAPACITY (in lb. per sq. in. of projected bearing area)

MATERIALS	1000 Hours Normal Operation	1000 Hours Heavy Duty Operation	100 Hours Max. Load Allowable
Conventional Babbitts Tin & Lead Base—.016 Thick	1500	1000	2000
Thin Babbitts Tin & Lead Base—.002-.005 Thick	2000	1500	3500
Copper-Lead (SAE 48)	3000	2000	4000
Aluminum Alloys	3500	2500	5500
Overlays Lead or Tin Alloy Plate	4000	2500	7000
Tin Bronzes	5000	3000	7500

if the babbitt lining materials are held to a .005" maximum thickness, the load at which the bearing material will commence fracturing for a given number of loading cycles will greatly increase. The fatigue phenomenon is best illustrated by the familiar process of breaking a piece of wire by rapidly flexing it back and forth. The internal friction and cold working eventually ruptures the material. In the thin-babbitt linings, the liner follows the flexing action of the steel very closely with less working effort on the material than with the conventional .010"-.020" thickness.

Of course, there is some variation from these nominal values within the given classifications, that is as the alloy specification changes. The high lead content babbitts have slightly less strength than the high tin alloys. Similarly, with copper-leads, the softer and weaker lead phase will reduce the load carrying capacity of a 25-30% lead alloy much below that of one with 5-10% lead.

Another important design consideration is that of the oil clearance required by the material. The tendency for copper-lead and aluminum alloys to "Seize" on the shaft requires that a greater space be provided than in the case of the babbitt. The clearance requirement is increased further in the case of the aluminum due to its very high coefficient of thermal expansion. Thus, an application which requires very close running clearances, may have to fall back on babbitts, though the imposed loads would tend to dictate the use of the higher capacity materials.

On the other hand, a relatively low load application operating in or near high heat may force the designer to use aluminum or one of the tin bronzes.

In the case of the overlay bearing—that is a copper-lead bearing material plated with a lead-alloy (.0005"-.002" thick) the load carrying capacity is appreciably increased. The exact manner in which the soft lead alloy affects the increase is not completely understood. However, the results of many tests indicate that the protection afforded the shaft and base bearing material during the critical break-in period is a very important factor. It is felt by many that the distress incurred in the first few hour's running determines the bearing's success or failure. Once the high spots are worn in and the minor misalignments are accommodated, the bearing, if still in good shape, will pile up long hours of successful operation.

The selection of the bearing material to be used cannot be made on the basis of only one desirable property. A tendency to corrode will rule out some materials; low fatigue strength disqualifies others; and the economic factor may prohibit still others. In brief, Load Carrying Capacity, like all the other properties of the various bearing materials, must be considered thoroughly in the light of all the design factors involved in the application at hand.

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Linde Air Products Co., 30 E. 42nd St., New York 17.
Welding rods—OXWELD

Link-Belt Co., 220 S. Belmont Ave., Indianapolis 6.
Malleable cast iron—PROMAL

Lithium Co., 111 Sylvan Ave., Newark 4, N. J.
Bronze bearing alloy—LITHLEAD

Littite Foundries Inc., Port Huron, Mich.
Alloyed gray iron—LITTITE

Little Falls Alloys, Inc., 189 Caldwell Ave., Paterson 1, N. J.
Silverplated beryllium-copper wire—SILVERCOTE

Lord Mfg. Co., Erie, Pa.
Vibration control mountings and custom parts of rubber-bonded-to-metal—LORD

Louthan Mfg. Co., The, East Liverpool, O.
Cordierite and Electrical porcelain, Steatite, and zircon specialties—ELEMITE
Ceramic insulations—LOUTHAN

Lukens Steel Company, Coatesville, Pa.
Carbon and low-alloy steel plates (including AISI and SAE grades)—LUKENS
Clad Steels, including Nickel-Clad, Stainless-Clad (all standard types) Stainless "20"-Clad Inconel-Clad and Monel-Clad Steels—LUKENS

Lumen Bearing Co., 197 Lathrop St., Buffalo 12.
Bearing alloys—LUMEN ALLOYS

Luzerne Rubber Co., Dewey St., Trenton, N. J.
Hard rubber, thermoplastic—LUZERNE

MacDonald Co. Inc., The, 805 W. Fourth St., Reno, Nev.
Hard surfacing electrodes—TEMDCO

Mackintosh-Hemphill Co., 901 Bingham St., Pittsburgh.
Cast iron—IRALITE
High tensile strength metal—MACHEMPITE
Alloy iron and alloy steel castings—ADAMITE

Magic Iron Cement Co., 1366 E. 34th St., Cleveland.
Cement and fillers — MAGIC PLASTIC LEAD, MAGIC IRON CEMENT, MAGIC PLASTIC BODY SOLDER, MAGIC GLAZE and SPOT PUTTY

Magnolia Metal Co., 16-20 E. Jersey St., Elizabeth, N. J.
Genuine babbitts—ADAMANT SUPER-GENUINE, POWER NICKEL-GENUINE D-Z-L GENUINE
Lead-base babbitts—MAGNOLIA ANTI-FRICTION METAL, DEFENDER, PYRAMID
Bearing bronze bushings—MAGNOLIA ISOTROPIC, MAGNOLIA AA, MAGNOLIA No. 120

Magnus Metal Corp., 111 Broadway, New York 6. (Also 80 E. Jackson Blvd., Chicago 4.)
Lead base alloy—SATCO

Maizewood Insulation Co., Dubuque, Iowa.
Fiber insulation board—MAIZEWOOD

Makepeace Co., D. E., Attleboro, Mass.
Laminated precious metals—MAKEPEACE

Mallory, P. R., & Co. Inc., Indianapolis.
Welding electrodes—ELKALOY MALLORY alloys, and ELKONITE
Copper base alloys—MALLORY
Electrical contacts—ELKONIUM and ELKONITE

Marblette Corp., The, 37-21 30th St., Long Island City, N. Y.
Plastics cast phenolic resin—MARBLETTE

Marbon Corp., 1926 W. 10th Ave., Gary, Ind.
Modified styrene plastics—MARBON "S"

Marco Chemicals Inc., Sewaren, N. J.
Plastics castings resins—MR-resins
Plastics laminates—MARCOBOARD

Marquette Mfg. Co. Inc., 307 E. Hennepin Ave., Minneapolis.
Welding rods, brazing compounds and solders—MARQUETTE

Masonite Corp., 111 West Washington St., Chicago.
Wood fiber panels—PRESDWOOD and BENELEX "70"

Massillon Steel Casting Co., Massillon, O.
Alloy cast steel—TIGERLOY

Maurath, Inc., 21800 Miles Ave., Cleveland 22, O.
Stainless electrodes—MAURATH

McKay Co., The, York, Pa., and Pittsburgh 22, Pa.
Arc welding electrodes — TOOL and DIE, HARDALLOY, FROGALLOY, NICKALLOY, PLURALLOY and McKAY

Medart Co., 180 Potomac St., St. Louis 18, Mo.
High tensile strength cast iron—HITEST
Abrasion-resistant cast iron—TUFTEST
Alloy steel forgings—SMAVROC

Meehanite Metal Corp., Pershing Square Bldg., New Rochelle, N. Y. (and foundries—see Meehanite in tradename listing)
General engineering, wear, heat and corrosion-resistant metals—MEEHANITE Metal

Metal Carbides Corp., Youngstown, O.
Tungsten carbide metal—TALIDE

Metallizing Engineering Co. Inc., Long Island City, N. Y.
Powdered hard-facing alloy—METCOWELD H

Metals Disintegrating Co. Inc., Elizabeth B, N. J.
Powder metals—MD Metal Powders

Metal & Thermit Corp., 120 Broadway, New York 5.
Welding electrodes — METAL & THERMIT, GENEX, GENEX M, ALTERNEX, MOLEX, CARBON-MOLY .50, HARDEX and M & T CROMANSIL

Metals Refining Co., Hammond, Ind.
Powder metal—MRCO

Mica Insulator Co., P. O. Box 1076, Schenectady 1, N. Y.
Laminated plastics—LAMICOID
Varnished paper, fabrics and Fiberglas — EMPIRE
Built-up Mica—MICANITE
Composite slot insulation—ARMATITE

Michiana Products Corp., Michigan City, Ind.
Heat-resisting cast alloys—MICHIANA

Michigan Seamless Tube Co., South Lyon, Mich.
Seamless tubing—MICHIGAN

Michigan Steel Casting Co., 1999 Guoin St., Detroit 7, Mich.
Stainless steel—MISCO METAL

Michigan Steel Tube Products Co., 9450 Buffalo St., Detroit 12, Mich.
Welded steel tubing—MICHIGAN

Midvale Co., The, Nicetown, Philadelphia 40, Pa.
Heat and corrosion resisting steels—MIDVALE
Cast-to-shape tool steel—MIDVALOY Hi-C Hi-CR

Miller Co., The, 99 Center St., Meriden, Conn.
Strip bronze—TREMBRONZE

Milne & Co., A., 745 Washington St., New York 14.
Tool steel tubes — MILNE HOLLOW DIE STEEL

M and M Wood Working Co., Portland, Ore.
Phenol-formaldehyde bonded exterior plywood—MALARKEY PLYWOODS

Modern Engineering Co. Inc., 3401-15 Pine Blvd., St. Louis 3, Mo.
Brazing rods and solders—MECO

Moccasin Bushing Co., 20th and Chestnut Sts., Chattanooga, Tenn.
Bronze alloys—MOCCASIN

Molex Products Co., 222 West Adams St., Chicago 6, Ill.
Thermoplastic plastics moldings—MOLEX

Molybdenum Corp. of America, Grant Bldg., Pittsburgh.
Alloying elements — MCA Molybdenum and MCA Ferro-Boron and MCA Tungsten

Monarch Alloys Co., Ravenna, O.
High-lead bronzes—MONARCH

Monarch Steel Co., Indianapolis, (also affiliated company, W. J. Holliday & Co., Hammond, Ind.)
Low-carbon, free-machining open-hearth steel—SPEED CASE
Medium-carbon, free-machining open-hearth steel—SPEED TREAT

Monsanto Chemical Co., Merrimac Div., Everett Station, Boston 49, Mass.
Silica aerogel insulation—SANTOCEL

Monsanto Chemical Co., Plastics Div., Springfield, Mass.
Cellulose nitrate plastics—NITRON
Cellulose acetate—FIBESTOS
Phenolic plastics—RESINOX
Polyvinyl acetal plastics—SAFLEX and ULTRON
Polystyrene, thermoplastics—LUSTREX
High heat-resistant thermoplastic—CEREX
Melamine plastics—RESIMENE
Polyvinyl chloride, copolymers and vinyl butyral—ULTRON

Moraine Products Div., General Motors Corp., 1420 Wisconsin Blvd., Dayton, O.
Bearing alloys—DUREX
Porous powdered metal—MORAINE

Morganite Inc., 3302 48th Ave., Long Island City, N. Y.
Carbon-graphite—MORGANITE

Mueller Brass Co., Port Huron, Mich.
Bearing alloy—MUELLER 600
Aluminum brass—TUFF-STUFF 224 E

Mullite Refractories Co., The, Canal St., Shelton, Conn.
Ceramic refractory—"SHAMVA" MULLITE

Mycalex Corp. of America, 60 Clifton Blvd., Clifton, N. J.
Glass-bonded mica—MYCALEX

National Alloy Steel Division, Blaw Knox Co., Blaw Knox, Pa.
Heat and corrosion-resisting castings — Na, Na-1, Na-2

National Bearing Div., American Brake Shoe Co., 4930 Manchester St., St. Louis 10.
Nonferrous centrifugal and precision castings, etc.—NATIONAL Metals
High-leaded bronze—TIGER

National Carbon Div., Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17.
Carbon (amorphous) or graphite—NATIONAL
Porous carbon—NATIONAL
Porous graphite—NATIONAL
Impervious carbon or graphite-base material—KARBATE
Carbon, graphite, metal-graphite brushes for motors and generators—NATIONAL

National Erie Corp., Erie, Pa.
Steel castings—NELOY and NELOY MOLY

National Formetal Co. Inc., 6604 Metta Ave., Cleveland 14.
Bushings and bearings—FORMETAL
Bronze—ESAY REAM

National Lead Co., 111 Broadway, New York 6.
Babbitt metal—DUTCH BOY and HOYT

National Malleable and Steel Castings Co., 10600 Quincy Ave., Cleveland 6, O.
Cast steel—NACO
Pearlitic malleable iron—H.T.M. and MALLIX

National Molded Products Inc., 122 Mill St., St. Marys, Pa.
Powder metal—NATIONAL

National Plastic Products Co., Odenton, Md.
Nontoxic resin—WYNENE
Thermosetting plastic sheets—NEVAMAR

National Plastics, Inc., 2330 McCalla Ave., Knoxville, Tenn.
Phenol formaldehyde plastic molding powders—PLASTONE

National-Standard Co., Niles, Mich.
Wires, braided wire and tapes—NATIONAL-STANDARD

National Supply Co., The, Torrance, Calif.
Carbon, alloy, and die steels—IDEAL ELECTRIC STEEL

National Tube Co., Frick Bldg., Pittsburgh 19.
Tubing, mechanical—U.S.S. SHELBY

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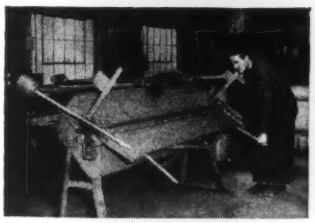

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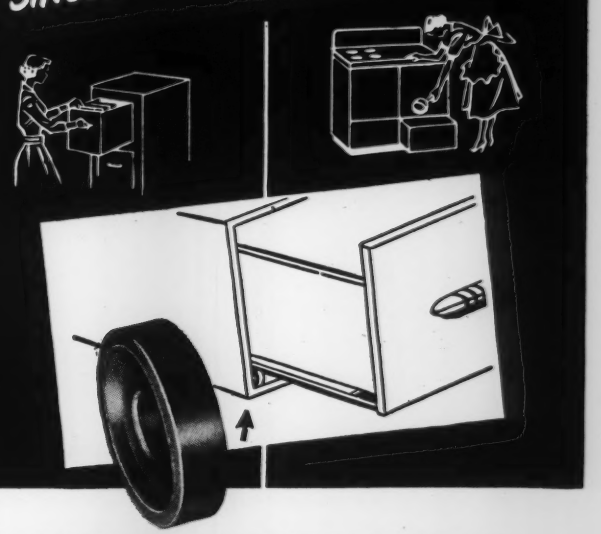
OFFICES IN PRINCIPAL INDUSTRIAL CITIES

See "Baskets, Wire" in your Classified Telephone Directory

Another Contribution to Industry through Powder Metallurgy by BOUND BROOK

YOU 3 MONEY-SAVING SINGLE "POWDIRON"



FOR EXAMPLE, DRAWER ROLLERS

CHECK these important benefits:

1. continuous lubrication between the shaft and roller.
2. smooth turning rollers, easy to assemble, without time-consuming machining.
3. no messy oil drips on cooking utensils or important filed data.

drawers that work . . . all the time . . . with ease

BOUND BROOK "POWDIRON" bearings and structural parts are:

- made from pure metal powders
- die-formed to shape
- alloyed at high temperatures
- finished to precise dimensions, AND
- vacuum-impregnated with lubricant

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BOUND BROOK

"COMPO" • "POWDIRON" • BOUND BROOK

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Cotton-rag base, fish-paper insulation — PEERLESS

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Plastic-elastomer compound—KRALASTIC

New England Tape Co. Inc., Hudson, Mass.
Plastics—NETCO

New Jersey Zinc Co., The, 160 Front St., New York 7, N. Y.
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Rolled zinc alloys—ZILLOY
Brass, bronze, copper, nickel-silver and zinc powders—NEW JERSEY ZINC

Ney Co., J. M., The, 71 Elm St., Hartford, Conn.
Corrosion-resistant alloys — PALINEY and NEY-ORO G

Nikoh Tube Co., 5001 S. Kedzie Ave., Chicago 32.
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Nitralloy Corp., 230 Park Avenue, New York. (licensees—see Nitralloy in tradename listing.)
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Nixon Nitration Works, Nixon, N. J.
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Cellulose nitrate—NIXON C/N
Ethyl cellulose—NIXON E/C
Rigid vinyl—NIXON V/L

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Ohio Carbon Co., 12508 Berea Rd., Cleveland 11.
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Ferro alloys—PHILO and RANIER

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High leaded nickel bronze—OLDS BEARING BRONZE

Oregon Plywood Corp., Sweet Home, Oregon.
Resin-bonded plywood — SWEET HOME BRAND

Orrweld Inc., 1228 Brighton Rd., Pittsburgh 33
Welding rods—ORRWELD

Owens-Corning Fiberglas Corp., Toledo, O.
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Alloy steel castings—CARCOMETAL

Pacific Mutual Door Co., Tacoma 1, Wash.
Plywood—PAMUDO

Page Steel & Wire Div., American Chain & Cable Co. Inc., Monessen, Pa.
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Penn Fibre & Specialty Co., 2030 E. Westmoreland St., Philadelphia 34.
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Penn Metal Co. Inc., 40 Central St., Boston 9.
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Pitt Metals Co., 4314 Main St., Pittsburgh 24.
Babbitt—PITT

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Pittsburgh Corning Corp., 307 Fourth Ave., Pittsburgh 22, Pa.
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Plastic Metals Div., The National Radiator Co., 177 Bridge St., Johnstown, Pa.
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Magnesium die castings—M-13

Precision Tube Co., 3828 Terrace St., Philadelphia 28.
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Price Associates, M. B., 350 Fifth Ave., New York.
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Pure Carbon Co. Inc., 445 Hall Ave., St. Marys, Pa.
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Powdered Metal Products Corp. of America, 9335 W. Belmont Ave., Franklin Park, Ill.
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Radio Cores Inc., 9540 Tully Ave., Oak Lawn, Ill.
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Rankin Mfg. Co., 3072 West Pico Blvd, Los Angeles 6, Calif.
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Reichhold Chemicals Inc., 601 Woodward Heights Blvd., Detroit 20.
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Reid-Avery Co. Inc., Dundalk, Baltimore 22, Md.
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Reilly Tar & Chemical Corp., Merchants Bank Bldg., Indianapolis.
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Reliance Steel Casting Co., 2818 Smallman St., Pittsburgh.
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Republic Steel Corp., Republic Bldg., Cleveland, Ohio.
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High Strength Steels—REPUBLIC ALDECOR, REPUBLIC COR-TEN, REPUBLIC DOUBLE STRENGTH, and REPUBLIC N.E.S. 70

Resinous Products & Chemical Co., 222 W. Washington Sq., Philadelphia 5.
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Compounded, modified polyvinyl-alcohol base —COMPAR
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Revere Copper & Brass Inc., 230 Park Ave., New York 17.
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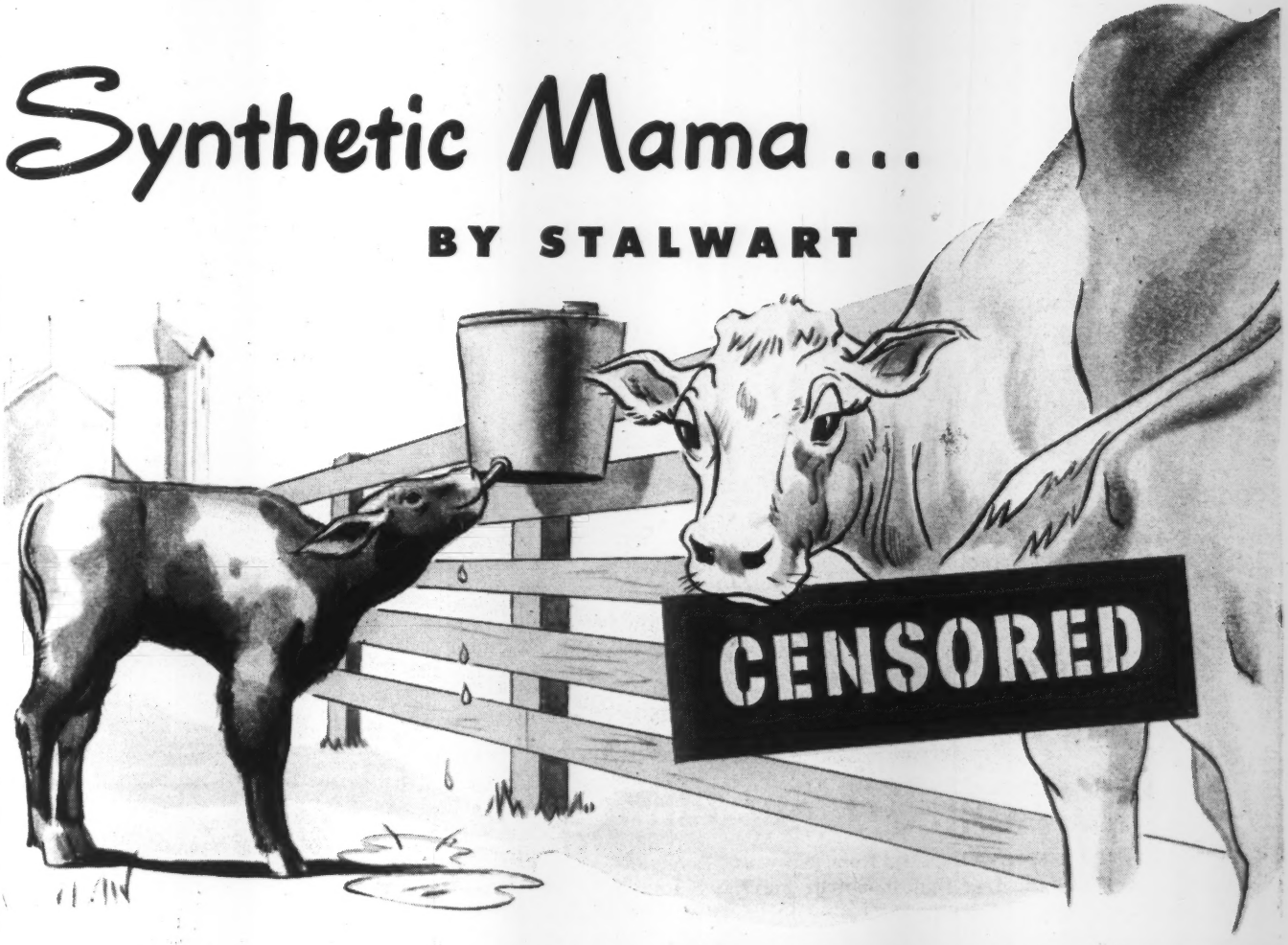
Rex Corp., 51 Lansdowne St., Cambridge, Mass.
Plastics extruded shapes—REXTRUDE

Reynolds Metals Co., 2500 S. Third St., Louisville 1, Ky.
Wrought aluminum alloys—REYNOLDS

Synthetic Mama...

BY STALWART



YOU'LL never specify a "synthetic mama", but your rubber part needs can be as specialized . . . to withstand extreme temperatures, chemicals, petroleum products, weathering, abrasion, tear, flex and other factors that cause premature equipment failure. Your rubber part problems can be solved quickly and accurately by Stalwart's highly skilled chemists and engineers.

Today, for example, STALWART is developing special rubber compounds and supplying custom parts in production quantities to the automotive, aviation, home appliance, refrigeration, and other original equipment manufacturing industries. Millions of molded, extruded, punched, and lathe or die-cut parts are fabricated daily from natural and synthetic stocks (including heat-resistant Silicone rubber) to meet individual as well as S.A.E. specifications.

Specify STALWART . . . For Quality Custom Rubber Parts.

SYNTHETIC MAMA'S PERSONALITY

STALWART was specified to develop a rubber teat suitable for attachment to an ordinary milk pail to facilitate controlled calf feeding. The purpose was to free "Mamas" for pasturing while calves were being fed a special diet.

The problems to be overcome in compounding and molding this teat, in spite of its apparent simplicity, were numerous.

1. Lactic acid resistance was a must
2. Compound had to be tasteless
3. Durability was necessary to withstand stretching and pulling
4. Orifice diameter had to be held to close tolerances
5. Rubber had to withstand continual wetting and drying as well as weathering
6. And, the "synthetic mama" had to resist the abrasive chewing of teething calves.

Stalwart's chemists and engineers solved the problem, and more than 20,000 "synthetic mamas" are shipped monthly to a manufacturer in the heart of the dairy land.

STALWART RUBBER COMPANY

10180 Northfield Road • Bedford, Ohio

using

SPEED ALLOY

Hot Rolled Alloy Plate

1 PURCHASING AGENT — Benefits from its availability (plates up to 72" wide and 6" thick) and the fact that it can be purchased flame cut to specified dimensions on a net weight basis, for rectangular plate necessary, making his job easier. Speed Alloy — newest of the SPEED STEELS — is economical from every angle.

2 TOOL & DIE MAKER — Benefits because Speed Alloy is easy to machine — as easy as any machinery steel — and he can get more work done faster. Tool life is longer. Less finishing time is required. Speed Alloy heat treats uniformly and holds its dimensions to extremely close tolerances. Can be welded when necessary.

3 DIE SHOP REPRESENTATIVE — Benefits because he is assured of pleased customers — "Time Saver" Speed Alloy provides economies that enables him to bid lower. Not a kick in a car load. Speed Alloy bridges the gap between carbon and tool steels. Its chromium and molybdenum content qualify it for tough jobs.

4 TOOL AND DIE SHOP'S CUSTOMER —Benefits by faster delivery (because of savings in machining time) lower costs, and quality moldings with fewer rejects. Indiana Foundry, Machine & Supply Co., Brazil, Ind., made the plastic extruding die above, using all three grades of Speed Steel plates, for General Plastics Corp., Marion, Ind., to extrude Tenite sheets 40" wide in thickness from .010 to .060. Different thicknesses are obtained by merely changing the outside die ring. Complete die weighs 2000 lbs. Get the facts — Bulletin 905.

SINCE 1856

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SPEED STEEL PLATE DIV.

136th & Sheffield Ave., Hammond, Indiana

Plants: Hammond and Indianapolis, Indiana

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Rohm & Haas Co., Washington Square, Philadelphia 5.
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Rohm & Haas Co., The Resinous Products Div., Washington Square, Philadelphia 5.
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Polyester resins in styrene—PARAPLEX

Ross-Meehan Foundries, 1601 Carter St., Chattanooga 1, Tenn.
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Ruberoid Co., 500 Fifth Ave., New York 18.
Asbestos cement board—STONEWALL
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Standard steels—RYERSON
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Heat treated alloy steels—RYCROME, NI-KROME "M", NITRALLOY, RY-AX
Steel mesh—RYEX

Ruby Chemical Co., The, 68-70 McDowell St., Columbus 8, O.
Solder—RUBYFLUID

Safetee Glass Co., Philadelphia 44.
Mirrors and glass—SAFETEE

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Seymour Mfg. Co., 87 Franklin St., Seymour, Conn.
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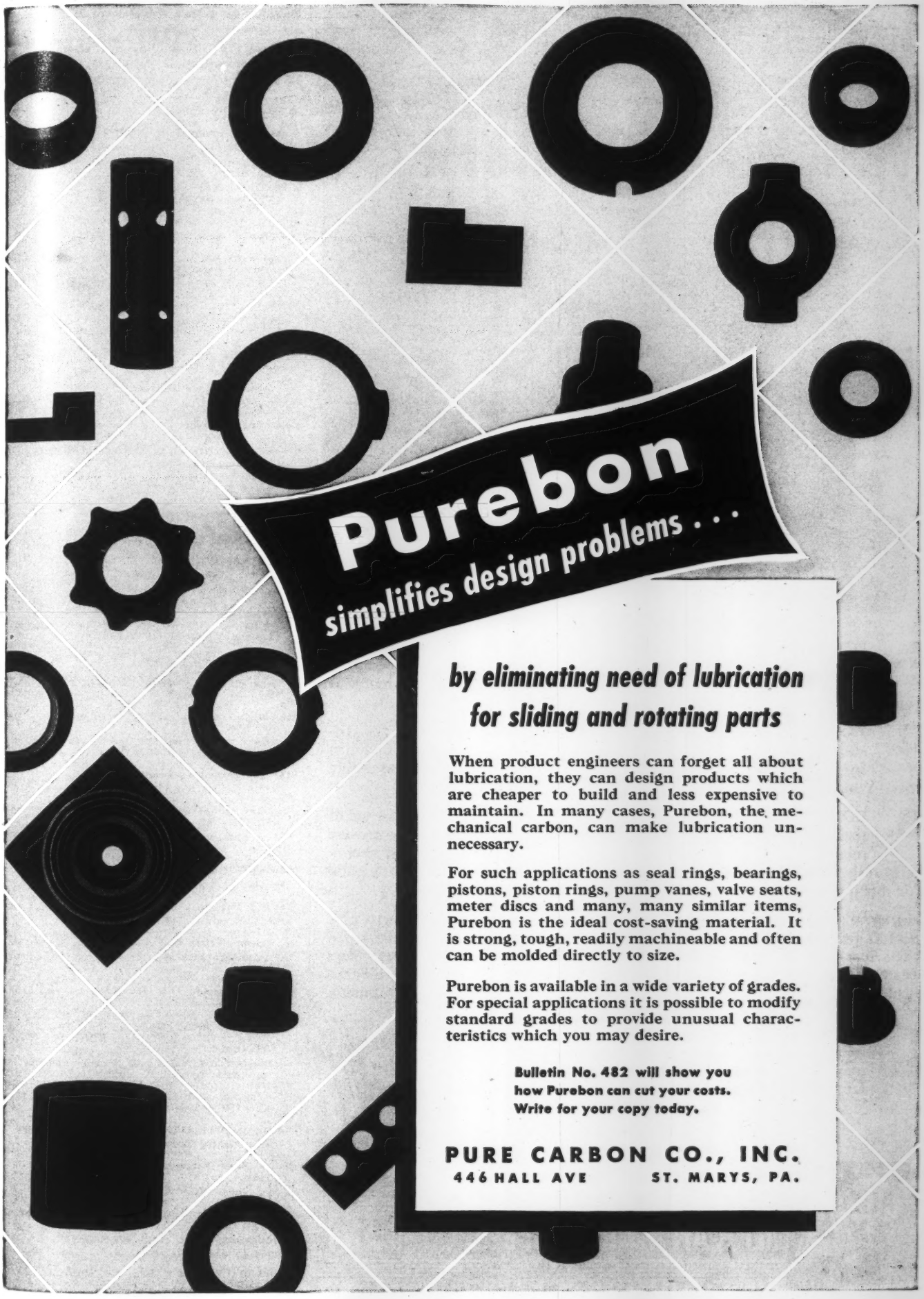

by eliminating need of lubrication for sliding and rotating parts

When product engineers can forget all about lubrication, they can design products which are cheaper to build and less expensive to maintain. In many cases, Purebon, the mechanical carbon, can make lubrication unnecessary.

For such applications as seal rings, bearings, pistons, piston rings, pump vanes, valve seats, meter discs and many, many similar items, Purebon is the ideal cost-saving material. It is strong, tough, readily machineable and often can be molded directly to size.

Purebon is available in a wide variety of grades. For special applications it is possible to modify standard grades to provide unusual characteristics which you may desire.

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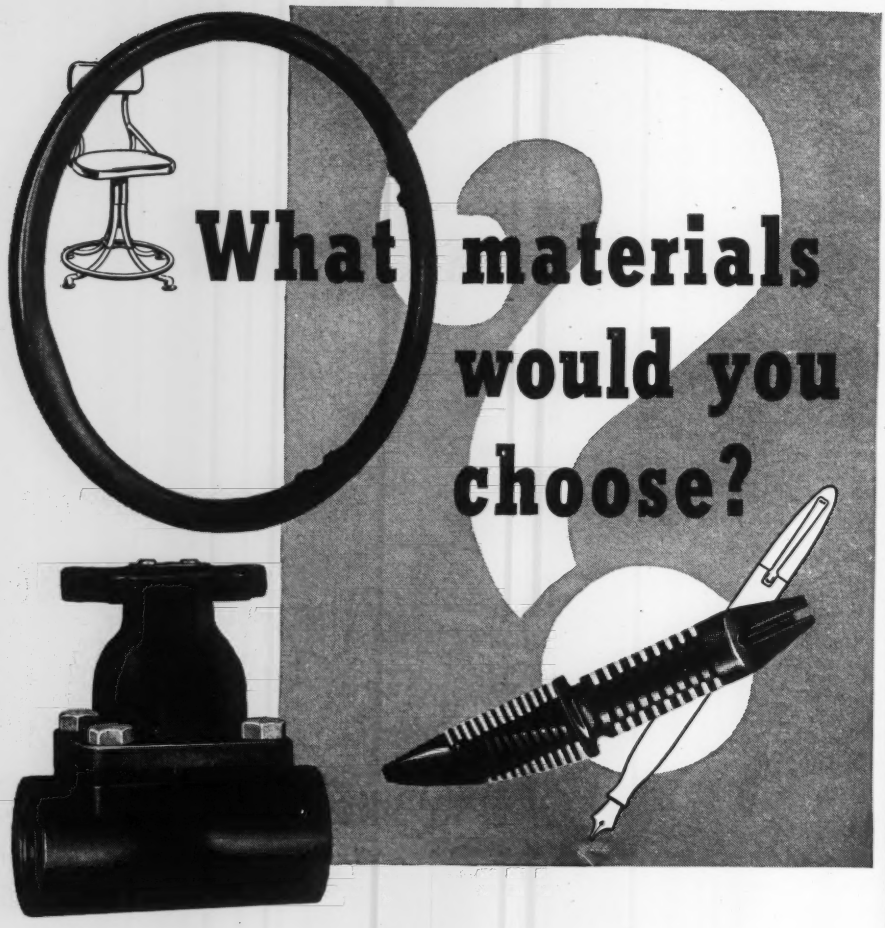

What materials would you choose?

1. FOOT RING FOR STOOL: Designers sought strong, abrasion resistant, smooth material that would never snag telephone operator's nylons, while resting her feet up off cold floor. What material would *you* use?

2. FOUNTAIN PEN FEED ROD: Required: material resistant to corrosion, machinable to close tolerances of 0.0005" with smooth finish for perfect flow of ink. Polished, attractive surface. All at reasonable cost. Your best pen probably uses this material. What is it?

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Answers: No. 1—Ace red hard rubber was molded over steel core to give perfect foot ring. An idea here for you? No. 2—This is one of many pen parts machined at high speed from Ace hard rubber rods and tubes. Sizes as small as $\frac{1}{16}$" O.D. up to 6" O.D. Samples on request. No. 3—Ace Saran is ideal for these valve bodies, products of Ace injection molding equipment.

Yes, sometimes it's hard rubber, and sometimes it's one of the other plastics that's best. Ace, with many hard rubber and plastics compounds to choose from, is fully equipped to supply whatever you need.

Ask for ACE Handbook

ACE Since 1851

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S-M-S Corp., 1165 Harper Ave., Detroit 11.
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Cast irons—SORBO-MAT

Spaulding Fibre Co. Inc., Tonawanda, N. Y.
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Transformer insulation — SPAULDING T BOARD

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Sponge Rubber Products Co., Shelton, Conn.
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Sponge rubber—SPONGEX
Foam rubber—TEXFOAM

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Standard Tube Co., 24400 Plymouth Rd., Detroit 28.
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Ceramics—LAVOLAIN, THERMOLAIN

Steel and Tubes Div., Republic Steel Corp., 224 E. 131st St., Cleveland 8.
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Stupakoff Ceramic & Mfg. Co., Latrobe, Pa.
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VISIT KENNAMETAL SPACE 808 ASM SHOW—SEE KENTANIUM

✓ Resists Thermal Shock
✓ Withstands Oxidation
✓ Retains Great Strength
at
HIGH TEMPERATURES

Kentanium greatly widens the scope of engineering design where conditions of intermittent or continuous high temperatures in oxidizing atmospheres are combined with abrasion, and compressive or tensile loads.

This new heat-resistant material is made in several different compositions, each having a specific combination of properties that meet a particular operating condition. The range of these properties is suggested in the table at the right. The proper composition for a specific application is determined by analysis of the conditions under which it will be used.

Kentanium compositions are composed mainly of titanium carbide with other refractory carbides, and an auxiliary metal. They provide higher strength and resistance to oxidation than cast alloys at 1800° F. and above; and greater thermal shock resistance than ceramics.

Our engineers are at your service to help you apply Kentanium to your needs.

Typical useful applications of Kentanium include: Elements of aircraft propulsion units; hot spinning tools; bushing and shear for hot rod; thermocouple protection tubes; hot extrusion dies; furnace parts; balls for hot Brinell testing; anvils for spot welding; and many others.

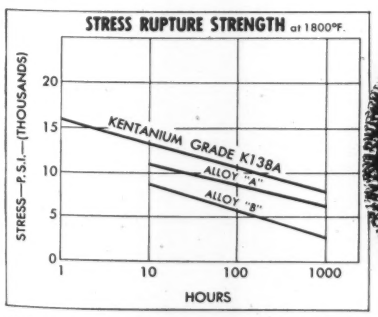
Characteristics

Property		Range
Specific Gravity GMS/cc		5.4—6.0
Thermal Conductivity cal/sec/°C./cm		.075—.085
Electrical Conductivity % of Copper Standard		1.9—5.0
Coeff. of Thermal Expansion x10-⁶/°F. up to 1200°F.		4.5—5.0
Rockwell A Hardness		87.5—93.0
Modulus of Rupture 1000 psi	Room Temp.	112—190
	1800°F.	Approx. 100
Young's Mod. of Elasticity 1,000,000 psi		51.2—57.3
Compressive Strength 1000 psi		Approx. 550

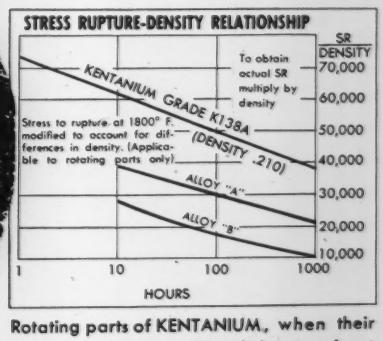
KENNAMETAL®
SUPERIOR CEMENTED CARBIDES

KENNAMETAL Inc., LATROBE, PA.

KENTANIUM
Remarkable New Heat-Resistant Titanium Alloy



KENTANIUM shows marked superiority in stress rupture characteristics over two commonly-used blade alloys.



Rotating parts of KENTANIUM, when their lower density is considered, have at least 100 times the service life of alloys.

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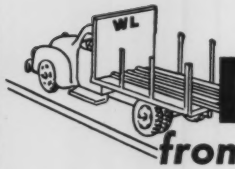
BILLETS AND FORGINGS FOR PRODUCTION, TOOL ROOM AND MAINTENANCE REQUIREMENTS.



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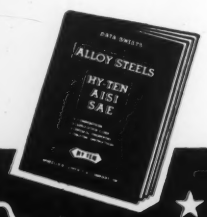

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Superior Bearing Bronze Co., 139 Banker St., Brooklyn.
Magnesium castings—SUPERIOR

Superior Carbon Products, Inc., 9115 George Ave., Cleveland, Ohio.
Carbon, graphite and metal-graphite—SUPER-GRAPH
Carbon—S.C.P.

Superior Metal Co., Clearing Station, Chicago 38.
Chrome-plated strip steel—SUPERIOR

Superior Steel Corp., Carnegie, Pa.
Stainless strip steel—SUPERIOR
Clad steel—SUVENEER

Superior Tube Co., 2010 Germantown Ave., Norristown, Pa.
Metal tubing (various metals)—SUPERIOR
Welded tubing—WELDRAWN

Surprenant Mfg. Co., Boston, Mass.
Thermosetting plastics—SURCO

Symington-Gould Corp., The, 2 Main Street, Depew, New York.
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Synthane Corp., Oaks, Pa.
Phenolic laminated plastics—SYNTHANE

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Taylor-Wharton Iron and Steel Co., High Bridge, N. J.
Alloy steels—TISCO
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Terre Haute Malleable & Mfg. Co., Box 180, Terre Haute, Ind.
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Thermal Syndicate Ltd., The, 12 East 46th St., New York 17.
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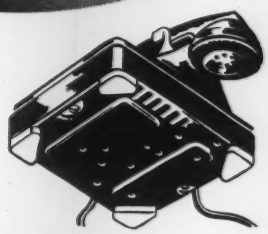
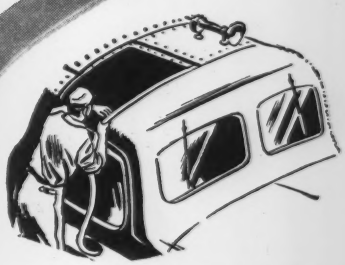
Normally supplied in rolls, DK-153 is also available in shapes die-cut to your specifications.

Send for free samples and further information to Armstrong Cork Company, Gaskets, Packings, and Seals Department, 7710 Arch Street, Lancaster, Pennsylvania. Armstrong's DK-153 Tape is available for export.



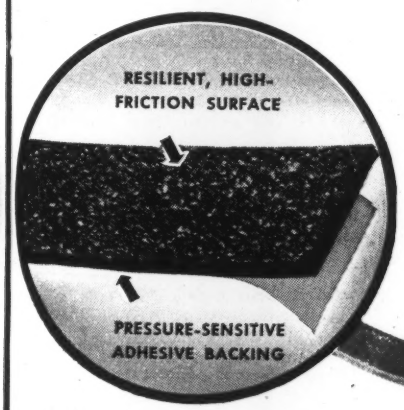
DIALING IS EASIER on polished desks and counters when telephones are equipped with non-skid DK-153.

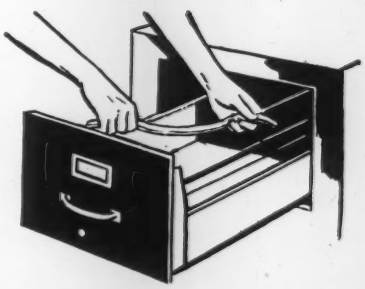


SQUEAKS ARE ELIMINATED on diesel locomotives and railway coaches with DK-153 Tape on rubbing parts.

ARMSTRONG'S DK-153 TAPE

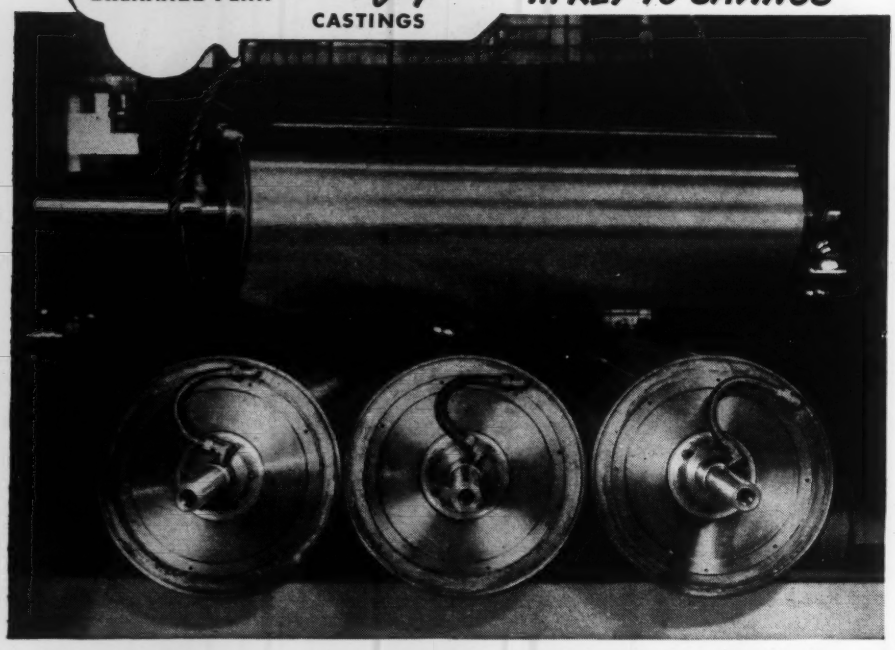
for faster, easier assemblies





FOLDERS WON'T SLIDE down out of sight in file drawers that are stripped with Armstrong's DK-153.

SHENANGO-PENN *Centrifugal* CASTINGS ... KEY TO SAVINGS



Bronze cooling drums, used in making imitation leather. Each drum is double cylinder, with brazed-in bronze spacers and heads. Journals are steel. Coolant is circulated between cylinders by means of flexible hose from journal.

TOUGH... COMPLEX... OR SIMPLE JOB

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FOR example, take the rather complex cooling drums shown here. Each drum consists of one cylinder within another, both centrifugally cast by Shenango's advanced technique. This in itself means exceptional strength to resist stresses and pressure . . . and fine, pressure-dense grain for avoidance of porosity and prolonged wear-life. It also means relief from sand inclusions, blow holes and other often-hidden defects.

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Titanium alloys—TAM

Tonawanda Electric Steel Casting Corp., 5 Mechanic St., North Tonawanda, N. Y.
Electric steel castings—TESCO

Trenite Corp., P. O. Box 159, Trenton, N. J.
Cast iron—TRENITE

Trent Tube Co., subsidiary Crucible Steel Co. of America, East Troy, Wis.
Stainless steel and Inconel tubing—TRENT-WELD

Trindl Products Ltd., 17 E. 23rd St., Chicago 16.
Mild steel welding rods—TRINDL SPEED-WELD

True Alloys Inc., 284 S. Summit, Detroit 9.
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Copper castings—TRU-CON

Tube Reducing Corp., 520 Main Ave., Wallington, N. J.
Cold-finished seamless tubing—ROCKRITE

Tyer Rubber Co., Andover, Mass.
Molded rubbers—TYER

Tyler, W. S., Co., 3615 Superior Ave., Cleveland.
Abrasion-resisting material—TY-LOY

Unimetal Co., 314 West Park St., Franklin, Pa.
Welding rod—UNIMETAL

Union Steel Casting Div., Blaw-Knox Co., 62nd and Butler Sts., Pittsburgh 1.
Alloy steel castings—ARMACAST, UNIVAN and UNIVAN "C"

Unitcast Corp., Steel Casting Div., Toledo 9, O.
Alloy and carbon electric steel castings — T-LOYS

United American Metals Corp., 200 Diamond St., Brooklyn 22, N. Y.
Babbitt metals — STONEWALL, AMERICAN Marine Genuine and UNITED AMERICAN

United States Graphite Co., Saginaw, Mich.
Porous metal—GRAMIX
Carbon-graphite—GRAPHITAR

United States Gypsum Co., Industrial Sales Div., 300 W. Adams St., Chicago 6.
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United States Plywood Corp., 55 W. 44th St., New York.
Resin-bonded plywood—WELDWOOD
Metal-covered plywood—ARMORPLY

United States Rubber Co., 2638 N. Pulaski Rd., Chicago 39, Ill.
Thermoplastic composition—ROYALITE

U. S. Rubber Co., 1230 Avenue Of The Americas, New York 20.
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Thermosetting plastic—ENRUP

United States Steel Corp., 436 Seventh Ave., Pittsburgh.
(See also American Steel & Wire Co., Carnegie-Illinois Steel Corp., Columbia Steel Co., National Tube Co., and Tennessee Coal, Iron & Railroad Co.)
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Alloy steels—U·S·S CARILLOY
Carbon steels and alloys—U·S·S AMERICAN QUALITY
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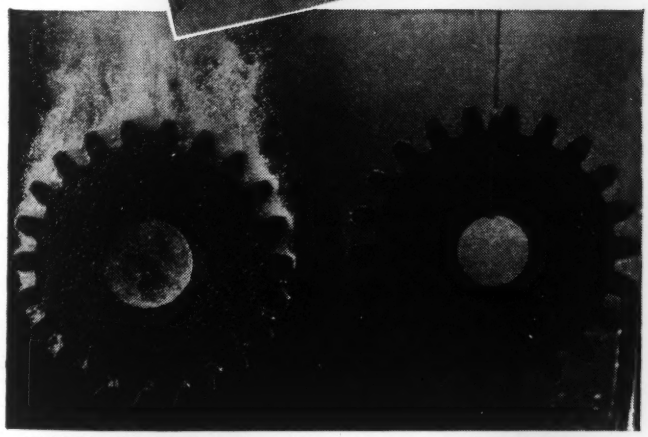

NO BATH FOR A SISSY. See how the 20 per cent solution of sulphuric acid eats away the steel gear at left, while the Enrup gear is unharmed. Enrup is the plastic that outwears steel, is non-conductive, non-absorbent, easy to clean, makes no noise when in operation. It has high tensile and impact strength, is unaffected by oils.

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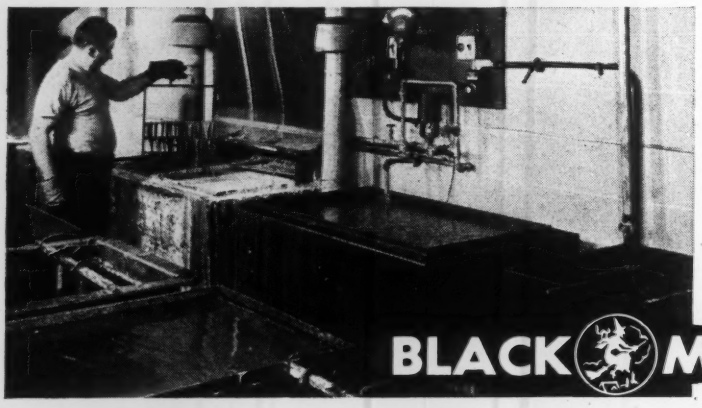

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Wire and tubing—UNITED WIRE
Brazing alloys—PHOSCO, PHOSON

Universal Clay Products Co., The, Sandusky, O.
Ceramic (porcelain) material—UNIVERSAL

Utica Radiator Corp., 2201 Dwyer Ave., Utica 2, N. Y.
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Valite Corp., New Orleans 12.
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Vanadium-Alloys Steel Co., Latrobe, Pa.
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Vascoloy-Ramet Corp., Waukegan, Ill.
Cast nonferrous alloys for machining and for heat and wear resistance—TANTUNG
Cemented carbide blanks, cutting tools, dies, and wear-resistant parts—V-R

Varflex Corp., 305 North Jay St., Rome, N. Y.
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Vellumoid Co., The, Worcester 6, Mass.
Sheet packing—VELLUMOID
Gasket material—VELLUTEX, VELBUNA

Victor Mfg. & Gasket Co., 5750 Roosevelt Rd., Chicago.
Compressed sheet packing—VICTOPAC
Vegetable fiber base sheet packing—VICTORITE
Asbestos sheet—VICTOR
Cork sheet—VICTOR
Compounded synthetic rubber—VICTOPRENE
Synthetic rubber—VICTOLENE

Visking Corp., Post Office Box 1410, Terre Haute, Ind.
Polyethylene thermoplastic plastics — VISQUEEN

Vulcanized Rubber & Plastics Co., Morrisville, Bucks County, Pa.
Hard rubber—AJAX

Wakefield Bearing Corp., Wakefield, Mass.
Impregnated maple bearings—WOODEX

Wall Colmonoy Corp., 19345 John R St., Detroit 3.
Hard facing welding rod—COLMONOY
Brazing alloy—COLMONOY NICROBRAZ

Washington Steel Corp., Washington, Pa.
Cold rolled stainless steel sheet and strip—MICRO-ROLD

Watertown Mfg. Co., Watertown, Conn.
Phenolic, thermosetting material—NEILLITE

Waukesha Foundry Co., Waukesha, Wis.
Copper-base high-nickel alloys, stainless steels, Monel and Inconel sand castings — WAUKESHA Metals

Weatherly Foundry & Mfg. Co., Commerce St., Weatherly, Pa.
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Alloyed white iron—NI HARD
Alloyed gray iron—NI RESIST

Webster Mfg. Inc., Hall St., Tiffin, O.
Pearlitic malleable iron—DURAMAL

Weirton Steel Co., Weirton, W. Va.
Zinc-coated sheets—WEIRZIN
Ductile sheets—WEIRALEAD

Welding Equipment & Supply Co., 223 Leib St., Detroit 7.
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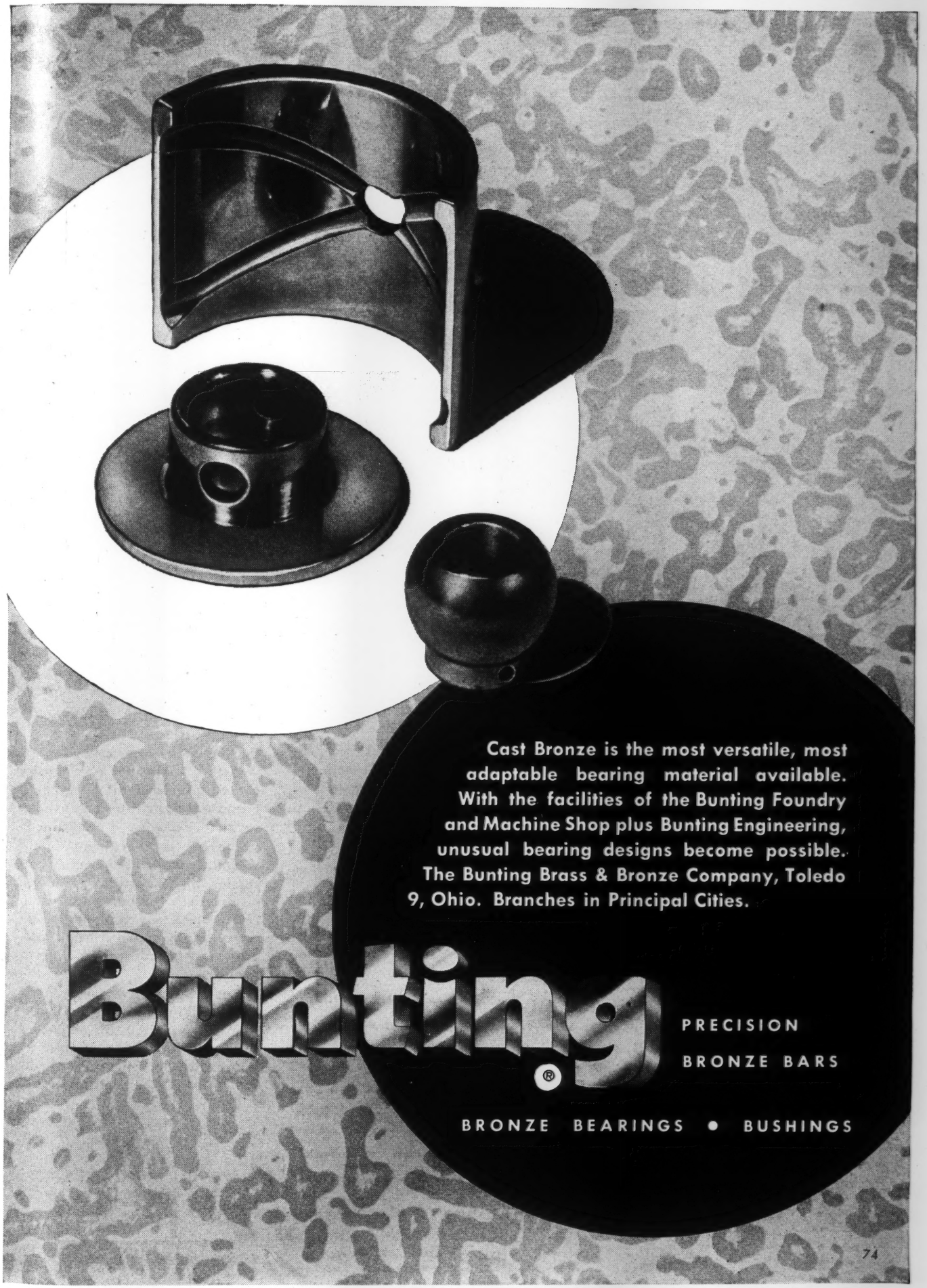
Wellman Bronze & Aluminum Co., 6017 Superior Ave., Cleveland.
Bearing bronzes—IDEALOY and ANFRILOY
Copper-base, aluminum and magnesium sand castings—WELLCAST and WELBRONCO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